Findings of Hypotension in Spinal Anesthesia Patients with Lumbar 3-4 And Lumbar 4-5

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Abstract

Background: Hypotension is a common complication associated with spinal anesthesia, often resulting from sympathetic nerve block. Factors such as the type of drug, patient positioning, injection site, dosage, and age influence the incidence of hypotension. **Purpose:** This study aimed to evaluate the incidence of hypotension in patients receiving spinal anesthesia at the lumbar 3-4 (L3-L4) and lumbar 4-5 (L4-L5) injection sites. **Methods:** A quantitative descriptive study with a cross-sectional approach was conducted, involving 190 respondents selected via purposive sampling. Univariate data analysis was performed. **Findings:** Findings indicated that patients receiving spinal anesthesia at the L3-L4 site experienced an average systolic blood pressure decrease of 24.69% and a diastolic decrease of 16.17%. In contrast, patients with L4-L5 injections showed a lesser reduction, with systolic pressure dropping by 15.51% and diastolic pressure by 12.31%. Additionally, the pulse rate decreased progressively within the first 20 minutes following induction. The average pulse rate at the 20th minute was 75.06 for patients with L3-L4 injections and 75.65 for those with L4-L5 injections. **Conclusion:** The study highlights that the incidence of hypotension varies based on the spinal injection site, with more significant decreases in blood pressure observed in patients receiving injections at L3-L4 compared to L4-L5. These findings have important implications for anesthesia management in clinical practice

Keywords: spinal anesthesia, hypotension, hemodynamics lumbar 3-4, lumbar 4-5.

Introduction

Hypotension is one of the most common complications during spinal anesthesia, which is more than 80%. Approximately 15 - 33% of the incidence of hypotension after spinal anesthesia most often occurs with each injection [1]. Regional anesthesia is a type of anesthesia used to inject local anesthetic drugs into nerve sites in certain regions to achieve analgesic and temporary relaxation of skeletal muscles.[2–4] Regional anesthesia consists of five types, namely nerve block, brachial flexus block, subarachnoid spinal block, epidural spinal block, and intravenous regional block [5].

In spinal anesthesia patients, too high sympathetic nerve block will result in bradycardia with a heart rate < 60 beats per minute and can cause a decrease in cardiac output. Hypotension can also be determined by evaluating mean atrial pressure or MAP during anesthesia, the average systolic and diastolic pressure; 20% or less than 60 mmHg of the preoperative value. Hypotension in patients undergoing spinal anesthesia is very common, hypotension can occur due to high sympathetic nerve

blockade causing fluctuant blood pressure [6].

In a study conducted by [7], it was found that there was a significant relationship between the height of the spinal anesthesia block and the incidence of hypotension, the risk of hypotension would be lower, if the height of the block was low, and the injection location at Lumbar 3-4 had hypotension as many as 71 (94.7%), while in the study by [8], the p value was 0.296> 0.05, which means that the injection location was not associated with the incidence of hypotension in sectio caesarea patients with spinal anesthesia.

Material and Methods

This research uses quantitative descriptive research. Cross sectional approach, which is an observational research design that analyzes data on the population at one time. The sample used was nonprobability sampling with a purposive approach. Inclusion criteria in this study are patients who will undergo surgery at Prof. Dr. Margono Soekarjo Purwokerto Hospital with anesthesia. Margono Soekarjo Purwokerto with spinal anesthesia, patients with lumbar injection points 3-4, patients with lumbar injection points 4-5, patients with ASA 1 - ASA 2, patients aged 20 - 75 years, agreeing to be respondents, patients undergoing spinal anesthesia using bupivacaine 0.5% with the addition of adjuvant fentanyl 25 mcg and exclusion criteria in this study are patients who do not agree to be respondents, emergency surgery, and patients with ERACS techniques.

Data analysis in this study used univariate analysis with descriptive statistical methods to describe the parameters of each variable involved. This study was conducted by observing blood pressure and pulse before induction of spinal anesthesia, 5 minutes after induction until 20 minutes after induction and recording on the observation sheet.

Findings

After the data analysis process, there were 190 respondents, with a total of 141 spinal anesthesia patients injecting at lumbar 3-4 and 49 patients with lumbar 4-5 injection points.

Table 1. Characteristics of Respondents Lumbar 3-4

Age	**f**	**(%)**
Teens (12-25 year)	7	5,0
Adult (26-45 year)	49	34,8
Elderly (46-65 year)	57	40,4
Older adults (>65 year)	28	19,9
Gender	**f**	**(%)**
Male	70	49,6
Female	71	50,4
Physical status	**f**	**(%)**
ASA 1	9	6,4%
ASA 2	132	93,6%
Total	141	100

The table 1. above shows that the majority of respondents have ages 46-65 years, namely 57 respondents (40.4%), the majority are female, namely 71 respondents (50.4%), and the majority of respondents with ASA 2, namely 132 respondents (93.6%).

Table 2. Characteristics of Lumbar 4-5 Respondents

Age	**f**	**(%)**
Teens (12-25 year)	2	4,1
Adult (26-45 year)	21	42,9
Elderly (46-65 year)	20	40,8
Older adults (>65 year)	6	12,2
Gender	**f**	**(%)**
Male	20	40,8
Female	29	59,2
Physical status	**f**	**(%)**
ASA 1	2	4,1
ASA 2	47	95,9

Total	49	100

The table 2. above shows that the majority of respondents have an age of 26-45 years, namely 21 (42.9%) respondents, the majority are female with 29 (59.2%) respondents, and the majority with ASA 2, namely 47 (95.9) respondents.

Table 3. Incidence of Hypotension in Spinal Anesthesia Patients with Lumbar Injection Points 3-4

	Mean	St.D
Initial systolic blood pressure	145.85	24.587
Blood pressure systole after induction	108.33	16.524
Decrease in systolic blood pressure (%)	24.69%	9.385%
Early diastolic blood pressure	82.99	11.234
Diastolic blood pressure after induction	68.74	11.915
Diastolic blood pressure reduction (%)	16.17%	16.737%

The average initial systolic blood pressure in spinal anesthesia patients with 3-4 lumbar injection points was found to be 145.85 then the average blood pressure after induction decreased to 108.33 with an average decrease in blood pressure of 24.69%, from initial systolic blood pressure to systolic blood pressure after induction. The average initial diastole blood pressure in spinal anesthesia patients with 3-4 lumbar injection points was 82.99 then the average diastole blood pressure after induction decreased to 68.72, with an average decrease of 16.17% from the initial diastole blood pressure to diastole blood pressure after induction.

Table 4. Incidence of Hypotension in Spinal Anesthesia Patients with Lumbar Injection Points 4-5

	Mean	St.D
Initial systolic blood pressure	142.53	16.462
Blood pressure systole after induction	120.12	19.724
Decrease in systolic blood pressure (%)	15.51%	8.576%
Early diastolic blood pressure	82.00	9.717
Diastolic blood pressure after induction	72.33	12.582
Diastolic blood pressure reduction (%)	12.31%	13.079%

The average initial systolic blood pressure was 142.53 then the systolic blood pressure after induction decreased to an average of 120.12 with an average decrease in initial systolic blood pressure to systolic blood pressure after induction decreased by 15.51%. The average initial diastole blood pressure in spinal anesthesia patients with lumbar injection points 4-5 was 82.00 then the average diastole blood pressure after induction decreased to 72.33 with an average decrease of 12.31% from initial diastole blood pressure to diastole blood pressure after induction.

Table 5. Pulse Rate in Spinal Anesthesia Patients with Lumbar Injection Point 3-4.

	Mean	St.D
Initial pulse	86.55	15.416
Pulse 5 minutes after induction	83.56	15.236
Pulse 10 minutes after induction	80.39	13.839
Pulse 15 minutes after induction	78.16	14.785
Pulse 20 minutes after induction	75.06	13.746

The table 5. above shows that there is a decrease in the average pulse in spinal anesthesia patients with lumbar injection points 3-4, namely the initial average pulse of 86.55, then at 5 minutes after spinal induction decreased to 83.56, and continued to decline until 20 minutes after induction, namely 75.06.

Table 6. Pulse in Spinal Anesthesia Patients with Lumbar Injection Points 4-5.

	Mean	St.D
Initial pulse	87.41	13.575
Pulse 5 minutes after induction	84.57	14.848
Pulse 10 minutes after induction	82.04	17.061
Pulse 15 minutes after induction	78.00	12.796
Pulse 20 minutes after induction	75.65	13.853

The above table shows the results that the average pulse in spinal anesthesia patients with lumbar injection points 4-5 decreased until 20 minutes after the induction of spinal anesthesia, the average initial pulse before induction was 87.41 then at 5 minutes after induction decreased with an average of 84.57, and further decreased until 20 minutes after induction which was 75.65.

Discussions

In this study, all spinal anesthesia respondents with injection points of lumbar 3-4 and lumbar 4-5 were given hyperbaric drugs, namely bupivacaine 0.5% with the addition of fentanyl 25 mcg as an adjuvant. In spinal anesthesia, fentanyl and local anesthetic drugs can be used together, which can prolong the duration of action and spread of sensory block, [9].

Age of respondents with lumbar 3-4 and lumbar 4-5 injection points

Spinal anesthesia is often chosen because it is quick, effective, reduces blood loss, and protects against thrombo-embolic complications. However, spinal anesthesia in the elderly can increase the risk of severe and prolonged hypotension, this is due to the rapid expansion of sympathetic block, which inhibits cardiovascular adaptation and increases morbidity and mortality, [10]. According to Hakim (2022), in a study conducted by [11], it was stated that as age increases, the elderly risk of hypotension greatly increases, this is supported by previous studies showing that a person with an age of >50 years has a 30% greater chance of experiencing hypotension than a young adult.

Gender of respondents with lumbar 3-4 and lumbar 4-5 injection points.

In this study, it was found that the majority of respondents in spinal anesthesia patients with lumbar injection points 3-4 and lumbar 4-5 were mostly female. According Bungawa (2011) in Sephia's research (2023), women have a higher tendency to experience hypertension, especially in old age. This is influenced by hormonal changes which are one of the factors causing hypotension in women.

Compared to non-obstetric patients, pregnant women have an increased incidence and rate of hypotension due to higher sensitivity to local anesthesia

combined with aortocaval compression of the pregnant uterus. In addition, pregnant women show increased sympathetic activity compared to parasympathetic activiy, [12].

Physical Status based on American Society of Anesthesiologists (ASA) in spinal anesthesia patients with injection points at lumbar 3-4 and lumbar 4-5.

The American Society of Anesthesiologists (ASA) is an assessment system to determine a person's health condition before receiving anesthesia for surgery, it is important to know the patient's physical status before undergoing anesthesia, because the ASA physical status assessment can determine whether the patient's condition is good or not, this assessment is used to predict the incidence of complications that will occur, both intra and post-surgery that require special attention. In a study conducted by [13], it was found that ASA 2 with mild systemic diseases such as essential hypertension and diabetes and mentioned that in patients with ASA II and ASA I, anesthesiologists often choose spinal techniques because they tend to have lower risks than other anesthesia methods, such as general anesthesia.[14–17]

An overview of the incidence of hypotension in spinal anesthesia patients with lumbar injection points 3-4.

Hypotension occurs due to vascular vasodilation, namely widespread sympathetic nerve block which can cause a decrease in cardiac output, decreased blood pressure, decreased heart rate and heart contractility, a decrease in blood pressure of more than 20% of the patient's initial blood pressure is defined as hypotensive events.
The main factor for a greater decrease in systolic blood pressure can be attributed to the high degree of spinal anesthesia blockade, but there are several factors that can also affect the occurrence of hypotension, such as drug dosage, age, etc.[18–21] Diastole blood pressure indicates arterial pressure when the heart is relaxed between two heartbeats, while systolic blood pressure indicates arterial pressure that increases when the heart contracts, [22].

Researchers assume that one of the factors for hypotension or blood pressure instability in spinal anesthesia patients with lumbar injection points 3-4 is influenced by widespread sympathetic nerve blocks, this will cause hypotension caused by venous and arterial vasodilation, vasodilation will result in an increase in venous volume and decrease venous return. Vasodilation reduces venous return to the heart and decreases cardiac output, this is supported in Nurhakiky's research (2022) entitled "The Relationship of Spinal Anesthesia Block Height with the Incidence of Intra Operative Hypotension" which shows significant results which means that there is a significant relationship between the height of the anesthetic spinal block and the incidence of hypotension and it is explained that the lower the height of the block, the lower the risk of hypotension, which is supported by the number of hypotension events in spinal anesthesia patients greater in lumbar 3-4, namely as many as 71 (94.7%) with moderate block height as many as 69 (92.1%) and those without hypotension as many as 2 (2.6%).

Spinal anesthesia injection points at lumbar 3-4 produce blockade up to ±T6 while at lumbar 4-5 injection points produce blockade at T8-T10, [23]. Spinal anesthesia blockade with lumbar 3-4 injection points is higher than lumbar 4-5 injection points because injections in lumbar 2-3 and lumbar 3-4 will tend to lead to cranial drugs, this will affect the height of sympathetic blockade and analgesic blockade produced. [4,24,25]

In a study conducted by [26], there is a relationship between block height and blood pressure, and if the height of the resulting block is higher, then blood pressure instability will be higher, spinal anesthesia patients who experienced blood pressure instability were 23 respondents due to the occurrence of block height above T7, several factors affecting the height of the spinal anesthesia block for each respondent, namely the height of the injection site.

Overview of hypotensive events in spinal anesthesia patients with lumbar injection points 4-5.

In this study, it was found that the decrease in systolic blood pressure with lumbar injection points 3-4 was greater, namely 24.69%, while at lumbar injection points 4-5 the average decrease was 15.51%, but the number of comparisons of respondents with lumbar injection points 4-5 was very small with 49 respondents compared to lumbar injection points 3-4 totaling 141 respondents to see the picture of the incidence of hypotension was not extensive.

Researchers assume that one of the greater occurrences of hypotension that occurs in spinal anesthesia patients with injection points at lumbar 3-4 can be due to the majority of respondents being elderly, compared to patients with lumbar injection points 4-5 with late adulthood, this is because elderly patients experience a decrease in cardiac output and nervous system response which can cause hypotension, this is supported in research conducted by Chusnah (2021), with the title "Relationship Between Age and Hypotension in Patients With Spinal Anesthesia" it was found that the risk of respondents experiencing hypotension increased if the respondent's age was higher.

In [27], it was found that there was a significant relationship between age and the incidence of hypotension in spinal anesthesia patients. Adult patients who experience sympathetic block until mid-thoracic may not cause hypotension or will only experience mild hypotension, but at an advanced age, a block of the same height will cause severe hypotension. Therefore, the risk of developing hypotension increases with the age of the responder. As age increases peripheral vasodilation results in a greater decrease in blood pressure, age over 50 years, the risk of hypotension will increase, [28].

In this study, the majority of the decrease in systole and diastole blood pressure in spinal anesthesia patients with lumbar 3-4 and lumbar 4-5 injection points was still classified as normal, the decrease in blood pressure continued to occur 5-20 minutes after induction of spinal anesthesia, this is in line with research conducted by [29], which says that the onset of hypotension which usually develops rapidly in 5-20 minutes due to decreased systemic vascular resistance, after induction of spinal anesthesia this period is considered the most critical period for patients.

Pulse picture in spinal anesthesia patients with lumbar injection points 3-4.

In this study, the average pulse of spinal anesthesia patients with lumbar injection points 3-4 decreased up to 20 minutes after induction, but the decline that occurred was still within normal limits with an average initial pulse of 86.55, 5-minute pulse 83.56, 10-minute pulse 80.39, 15-minute pulse 78.16, and 20-minute pulse 72.00.

Researchers assume that pulse instability is also influenced by the sympathetic block produced by spinal anesthesia which reduces stimulation of

stretch receptors in the atrial wall, these receptors work to regulate blood pressure and heart rate, this is supported in research conducted by Kurniadita (2021) which states that the level of hemodynamic instability, or the patient's pulse will increase along with the height of the spinal anesthesia block.

Pulse rate in spinal anesthesia patients with lumbar injection points 4-5.

The average pulse rate in spinal anesthesia patients with lumbar injection points 4-5 decreased up to 20 minutes after induction of spinal anesthesia. Researchers assume that pulse instability is dominated by lumbar 3-4 because sympathetic nerve block in spinal anesthesia patients is more extensive than spinal anesthesia patients with lumbar 4-5 injection points, because spinal anesthesia injections at lumbar 3-4 experience block -+T6 and at lumbar 4-5 injections experience block at T8-T10, This is in line with research conducted by Kurniadita (2021), it was found that 24% of respondents experienced pulse instability which could be caused by blocks above T7, and 76% of respondents experienced a stable pulse, this is because most experienced blocks below T6 in accordance with the height of the block in surgery and skin.

Limitations and Future Research

The limitations of this study are the comparison of respondents of spinal anesthesia patients injecting at lumbar 3-4 and lumbar 4-5 is very different, this according to researchers is not broad enough to be seen, in terms of age, and drug doses, researchers also only see a picture not examining further, especially related to dosage, researchers only limit the dose of bupivacaine given because researchers know that drug doses are very influential on hemodynamic instability.

Conclusion

The characteristics of respondents in this study were mostly female, with the age of late adulthood to the elderly. The ASA physical status of spinal anesthesia patients with lumbar 3-4 and lumbar 4-5 injection points is the majority with ASA 2. The incidence of hypotension in spinal anesthesia patients is the majority in patients with lumbar 3-4 injection points, a decrease in pulse in patients undergoing spinal anesthesia with lumbar 3-4 and lumbar 4-5 injection points experiencing instability that is still within normal limits, this pulse instability occurs up to 20 minutes after induction of spinal anesthesia, but the majority of pulse decreases in spinal anesthesia patients occur in lumbar 3-4 with a value of 75.06.

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Conflict of Interest Statement

The authors have confirmed that they have no competing interests.

Data Avaibility

The datasets used or generated in this study are available from the corresponding author upon reasonable request.

Author Contributions

Melani Setiaputri Amir: Involved in the study's conception and design, database searching, methodology development, data analysis and interpretation, as well as writing, reviewing, and editing. **Danang**

Tri Yudono: Contributed to the conception and design of the study, database searching, methodology, data analysis and interpretation, along with writing, reviewing, and editing**. Made Suandika:** Participated in the study's conception and design, database searching, methodology development, data analysis and interpretation, and writing, reviewing, and editing

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