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RISK FACTORS FOR HYPOTENSION AFTER SPINAL ANESTHESIA

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Spinal anesthesia is widely used in everyday clinical work. Hypotension is one of the most frequent side effects of spinal anesthesia. Knowledge of the risk factors for hypotension is useful in increasing the vigilance in those patients most at risk for hypotension, enabling a timely therapeutic intervention. The aim of this study was to identify the factors associated with hypotension after spinal anesthesia, using the data of a group of patients who underwent elective surgery. The study involved 89 patients, classified by the American Society of Anesthesia (ASA) as of physical status I to III, who were scheduled to have elective surgery with spinal anesthesia. Patients were allocated to groups depending on their age, gender, chronic alcohol intake, preoperative history of hypertension or hypotension, vascular disease, endocrine diseases, ASA physical status, Lee's index and type of surgery. Hypotension was encountered in 29 (33%) patients. One patient (3%) had a history of chronic alcohol abuse. A large number of patients had physical status II as classified by the ASA, 22 (77%) and by the Lee's index, 28 (97%) patients were in the group with a low cardiac risk. The most frequent incidence was during an orthopedic surgery (77%). The knowledge of these risk factors should be useful in suggesting the use of alternative methods of spinal anesthesia, such as titrated continuous or small-dose spinal anesthesia. *Acta Medica Medianae 2017;56(2):105-110.*

Key words: *spinal anesthesia, hypotension, risk factors*

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Introduction

Spinal anesthesia (SpA) is often recommended as a safe and preferred choice over general anesthesia. The hemodynamic benefits of spinal anesthesia over general anesthesia include a minimum decrease in myocardial contractility and only modest decreases in blood pressure and cardiac output. Hypotension, with an incidence of 15% to 33% (1) is one of the most frequent side effects of spinal anesthesia. The clinical importance of these side effects was shown in the study by Sanborn et al. (2), who proved that hypotensive episodes detected by an automated record-keeping system clearly correlate with mortality. Postoperatively, cases of spinal anesthesia associated severe bradycardia have been described to occur up to five hours after arrival in the Post-Anesthesia care Unit (PACU) (3). Factors contributing to the development of hypotension early after spinal anesthesia placement have been well documented. Acute hemodynamic effects of spinal anesthesia may be explained by simpatholysis, resulting in three major hemodynamic effects: decrease in venous return (in turn influenced by posture, bleeding and inferior vena cava compression), vasodilatation and decreased cardiac output (3). Severe hypotension may cause the parturient to develop nausea, vomiting, loss of consciousness or even cardiac arrest (4, 5). In addition, hypotension may cause hypoxia, acidosis or even damage to the central nervous system in the fetus by reducing uteroplacental blood flow. Therefore, perioperative maintenance of hemodynamic stability is important for the parturient. Many studies have been conducted concerning prophylaxis and therapy of hypotension after spinal anesthesia or epidural anesthesia (6, 7).

Aim

The aim was to identify the factors associated with hypotension after spinal anesthesia using the data from a group of patients who underwent elective surgery.

Patients and methods

The study involved 89 patients, classified by the American Society of Anesthesia (ASA) as physical status I to III, who were scheduled to have elective surgery with spinal anesthesia. All the patients were hospitalized in the General Hospital Leskovac or in the Clinic of Abdominal Surgery, Clinical Center Nis, from February to June 2016. The patients were allocated to groups depending on age, gender, chronic alcoholic consumption (defined as more than three alcoholic drinks per day), preoperative history of hypertension or hypotension, vascular diseases, endocrine diseases, ASA physical status, Lee's index and a type of surgery.

Spinal anesthesia was induced at L2-L3 or L3-L4 interspaces using a 24G Quincke type of spinal needle. The local anesthetics we used were plain Bupivacaine 0,5% (3 ml) and L-bupivacaine 0,5% (3 ml).

The motor blockade was achieved if patients could not move their legs after an injection of local anesthetic. The sensory blockade was checked by stinging and pinching or feeling the heat or cold.

There was a continuing monitoring of electrocardiography (ECG), heart rate (HR), median arterial pressure (MAP), and oxygen saturation (SpO2) during a surgery. Hemodynamic variables and SpO2 were recorded before spinal anesthesia and every 5 minutes during the surgery.

In this study, we investigated only the cases of hypotension. Hypotension was defined as follows: a decrease in MAP of more than 30% from baseline values within a 10-min interval, plus a therapeutic intervention by the attending anesthesiologist (administration of an additional bolus of 500 ml of crystalloid and/or colloid and/or administration of a vasoconstrictor, phenylephrine (50-100 mcg)).

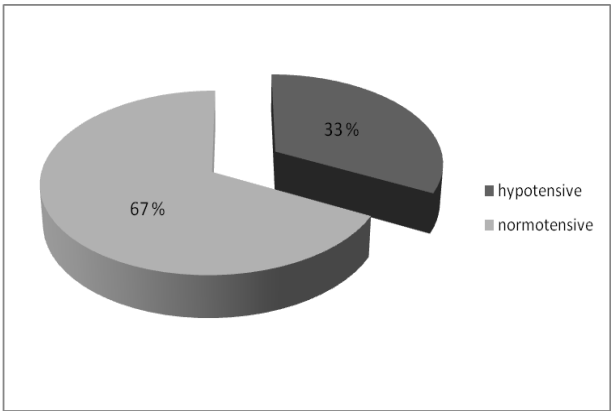
The results were presented using a pie chart and shown in tables, represented as the total number and percentage of the patients. Intergroup differences were tested by t-Student's test. The value of $p<0,001$ was considered as a statistically significant difference.

Results

A total of 89 patients were enrolled in this prospective study. Hypotension was detected in 29 (33%) patients (Figure 1). There were 13 (45%) males and 16 (55%) females undergoing elective surgical procedures in spinal anesthesia. The average age of patients was 67±9 years.

One patient (3%) was a chronic alcohol abuser.

A large number of patients, 22 (77%), were classified as physical status II according to the ASA. As physical status III 5 patients (17%) were classified, and 2 patients (6%) were classified as physical status I.



Graphic 1. Patients enrolled in the study

According to the Lee's index, most of the patients were in a group with a low cardiac risk, 28 (97%). Only one patient (3%) was in a group with milder cardiac risk. According to these results, it was obvious that preoperative health condition of the patients had large influence on the possibility that a patient develop an episode of hypotension after spinal anesthesia ($p<0,001$).

Preoperative disease history was classified among the possible risk factors (Table 1). Preoperative history of hypertension was the number one risk in these patients ($p<0,001$).

Table 1. Preoperative diseases as the risk factors for hypotension after spinal anesthesia

	Patients	
Preoperative disease	(n)	(%)
Hypertension	18	62
Hypotension	1	3
Vascular disease	2	7
Diabetes mellitus	2	7
Hypothyreosis	1	3
Total	24	82

The type of surgery had a big influence on the incidence of hypotension after spinal anesthesia ($p<0,001$). Hypotension most commonly occured during orthopedic surgery (Table 2).

Table 2. Incidence of hypotension after spinal anesthesia depending on the type of surgery

	Patients	
Type of surgery	(n)	(%)
Abdominal	3	10
Orthopedic	22	77
Urology	3	10
Gynecology	1	3
Total	29	100

Discussion

Hypotension is one of the most frequent side effects of spinal anesthesia. The results of this study show that 33% patients have hypotension after spinal blockade. Carpenter et al. (8) have had the same results. They defined hypotension as a systolic blood pressure <90mmHg or, alternatively, as a 10% decrease from the baseline in patients with baseline blood pressure <90 mmHg. Tarkkila and Isola (9) defined hypotension as a decrease in systolic blood pressure of more than 30% from the pre-anesthetic value or a decrease in systolic blood pressure below 85 mmHg. They detected the episodes of hypotension in 15.3% of their patients. As the number of risk factors rose, the incidence rose too.

Different factors might be related to the risk for hypotensive episodes after spinal block, such as anesthetic technique, history of hypertension, basal heart rate and obesity (10). The results published in the literature suggest that patient's age is a very important risk factor in spinal anesthesia (11, 12). In our study, the average age of patients was 67±9 years. We found that the incidence of hypotension was higher in elderly patients. Hypotension is common and also more hazardous in the elderly, as they may have decreased physiological reserve and compromised blood supply to various vital organs. The changes in cardiovascular physiology associated with aging and disease reduce cardiovascular reserve and may predispose the elderly to hemodynamic instability (13).

The elderly have increased resting sympathetic nervous system activity and associated increased norepinephrine release from the nerve terminals (14). The loss of sympathetic efferent activity would thus be expected to exacerbate further the decrease in systemic vascular resistance (SVR) with spinal anesthetic in the elderly (10-15%). Hypovolemia makes the situation even worse. Intravenous administration of fluids, avoidance of aortocaval compression and vigilant monitoring of blood pressure at frequent intervals are the measures to decrease the risk of hypotension to varying degrees, but none have been shown to be sufficient (15).

Veins stiffen with age and consequently do not accept the same amount of blood as those of young people. The inability of elderly veins to dilate with the loss of sympathetic nervous system activity could help explain the modest 6% increase in the leg blood volume (14, 15). Rooke et al. (14) demonstrated an increase in blood volume in most of the abdominal organs in elderly subjects. On the contrary, a decrease in blood pressure, cardiac output, and sympathetic tone, as a response to spinal anesthesia in young and healthy subjects, might be expected to decrease both splanchnic blood flow and abdominal blood volume, although not necessarily to the same degree (14-16).

In this study, there was only one patient (3%) with chronic alcohol abuse. Patients with chronic alcohol consumption showed a threefold increase of the risk for a relevant blood pressure decrease (17). Because of alcohol-based neuropathy, the sympathetic nervous system is affected, leading to orthostatic deregulation. Since lower levels of catecholamine can be observed after alcohol deprivation, alcoholics seem to compensate for latent hypovolemia with an increased output of catecholamine. Spinal anesthesia reveals this compensatory mechanism (17, 18). The greater number of patients in this study were classified as physical status II by the ASA, 22 (77%). There were 5 patients (17%) with ASA physical status III, and 2 (6%) patients were with ASA physical status I. According to the classification of Lee et al., there were 28 (97%) patients in the group with low cardiac risk. Only one (3%) patient belonged to the group with milder cardiac risk. These results thus suggest that preoperative disease history can have an impact on the incidence of hypotension after spinal blockade ($p<0,001$).

Spinal anesthesia is often recommended as a safe procedure and a preferred choice over general anesthesia. Hemodynamic benefits of spinal anesthesia over general anesthesia include a minimum decrease in myocardial contractility and only modest decreases in blood pressure and cardiac output (14). On the contrary, there are studies stating that sympathetic nervous system activity increases in the elderly and in those with congestive heart failure; such patients could thus be at risk of greater decreases in systemic vascular resistance (SVR), myocardial contractility, and blood pressure than young and healthy subjects (14).

The consequences of peripheral blood pooling might also be exaggerated during spinal anesthesia in the elderly and in those with cardiac dysfunction, since such patients are dependent on left ventricular end-diastolic volume (LVEDV) to maintain the stroke volume and cardiac output (14-16). Rooke et al. (14) described an increased EF in subjects with baseline EF of ≥ 50% and it was unchanged in those with a baseline EF of <50%. In this study, we found the preoperative history of hypertension as the most important patient-related factor associated with increased risk for hypotension. Chronic medications were taken by 18 (62%) patients. In patients with known hypertension, the risk for a relevant decrease in blood pressure is nearly twofold (19). Chronic medications taken by the subjects can lead to an increased abdominal blood volume (14). There were conflicting reports on the continuation of angiotensin-converting enzyme (ACEI) on the day of surgery in patients undergoing regional anesthesia (20). There is inadequate evidence of the effects of calcium channel blockers and β-blockers on blood pressure in hypertensive patients undergoing spinal anesthesia. Since hypertensive patients can have end-organ damage, a sudden hypotension episode could have a detrimental effect. Greater increases in mesenteric blood volume were present in the patients taking calcium channel blockers than in those who were not. Absence of tachycardia may have helped to prevent myocardial ischemia,

despite the hypotension. Kaimar et al. (20) reported that some exaggerated hypotension did occur in patients on calcium channel blockers. This could be partly explained by the vasodilator property of the drug which could have had an added effect after spinal anesthesia-induced hypotension. The subjects' chronic medications and sympathetic blockade may have protected the subjects from tachycardia. Bradycardia following spinal anesthesia was entirely limited to the patients who used β-blockers. These characteristics were especially attractive for high-risk patients, including those with known cardiac disease.

Many studies examined the response to spinal anesthesia depending on the level of the spinal blockade (21, 22). High spinal anesthesia is associated with a decrease in liver and kidney blood flow, but low spinal anesthesia is not.

In this study, all patients underwent elective surgery. Patients undergoing elective surgery were adequately examined and received preoperative therapy of the existing diseases and volume conditions. Emergency patients, in contrast, are not always in a state of homeostasis. Preexisting conditions, especially cardiac disease, may be inadequately assessed. Furthermore, stress encountered in emergency situations, which lead to an increased sympathetic tone or trauma- associated stress and blood loss are the factors that can affect circulatory variables, all which must be considered during spinal anesthesia. In this study, we also considered the type of surgery as a risk factor of hypotension. We found a higher incidence of hypotension during the orthopedic surgery ($p<0,001$).

Conclusion

Hypotension is one of the most frequent side effects of spinal anesthesia. Many studies have been conducted concerning the prophylaxis and therapy of hypotension after spinal anesthesia. In this study, we describe patient age, preoperative history of hypertension and type of surgery as the factors associated with increased risk for hypotension. Hypotension occurred frequently during the orthopedic surgery. There were more patients classified as ASA physical status III than those belonging to physical status I. Preoperative chronic medications were described as the major risk factor for hypotension after spinal blockade. The knowledge of these risk factors should be useful in increasing vigilance in those patients most at risk for hypotension, allowing for a more timely therapeutic intervention, or even suggesting the use of alternative methods of spinal anesthesia, such as titrated continuous or small-dose spinal anesthesia.

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FAKTORI RIZIKA ZA NASTANAK HIPOTENZIJE NAKON SPINALNOG BLOKA

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Spinalna anestezija ima veliku primenu u svakodnevnoj kliničkoj praksi. Najčešći neželjeni efekat spinalnog bloka je hipotenzija. Poznavanje faktora koji doprinose njenom nastanku može nam pomoći u efikasnijem kliničkom tretmanu ovih bolesnika. Cilj studije bio je da se evaluacijom podataka bolesnika koji su bili podvrgnuti hirurškoj intervenciji u spinalnom bloku prepoznaju faktori rizika za nastanak hipotenzije. Prospektivnom studijom obuhvaćeno je 89 bolesnika koji su bili podvrgnuti elektivnoj hirurškoj intervenciji u spinalnoj anesteziji. Grupisani su zavisno od: godina starosti, pola, životnih navika, preoperativnih anamnestičkih podataka o pratećim oboljenjima, ASA statusa, Lijevog indeksa srčanog rizika i vrste hirurške intervencije. Pad krvnog pritiska nakon bloka opisan je kod 29 (33%) bolesnika. Od ukupnog broja ispitanih bolesnika jedan je hronično konzumirao alkohol (3%). Najveći broj bio je ASA statusa II, 22 (77%), a po Lijevom indeksu većina je pripadala grupi sa niskim srčanim rizikom 28 (97%). Hipotenzija se najčešće javljala tokom operativnog zbrinjavanja ortopedskih bolesnika (77%). Poznavanje faktora rizika može biti korisno za poboljšanje profilakse onih bolesnika koji su pod visokim rizikom od nastanka hipotenzije nakon spinalnog bloka. Takođe, može se sugerisati primena alternativnih metoda, kao što su kontinuirana spinalna anestezija ili izvođenje spinalnog bloka aplikovanjem malih doza anestetika. *Acta Medica Medianae 2017;56(2):105-110.*

Ključne reči: *spinalni blok, hipotenzija, faktori rizika*