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Original Scientific Paper

CLINICAL EFFECTS OF HYPERBARIC LIDOCAINE AND BUPIVACAINE IN SPINAL ANESTHESIA – OUR EXPERIENCE

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ABSTRACT – *Introduction.* Various side effects and complications in the perioperative period can occur with the use of hyperbaric lidocaine and bupivacaine. *Goal*. Comparative presentation of the occurrence of side effects and complications of hyperbaric lidocaine and bupivacaine during spinal anesthesia in our patients. *Methods.* The study was retrospective and included 178 patients of both sexes. Patients were divided into two groups. In Group I (n-98) hyperbaric lidocaine 5% was used for spinal block. Group II (n-80) was divided into 2 subgroups, A- where hyperbaric Markain 0.5% was used (n-51), and B (n-29) where hyperbaric Sensorkain 0.75% was used. In the study, we analyzed gender, age, block onset, and complications. *Results.* There were 98 patients in Group I, 79 males and 19 females. There were 80 patients in Group II, 69 males and 11 females. The mean age of patients in Group I was 44.96 and in Group II 48.16 years. There was no statistically significant difference in the age of patients in both groups $p > 0.05$ ($p = 0.2321$). The occurrence of spinal block occurred significantly faster in Group I compared to group II ($p < 0.0001$), and in subgroup B faster than in subgroup A ($p < 0.005$). The clinical occurrence of complications and side effects during spinal anesthesia is somewhat more common in spinal block with 5% lidocaine. *Conclusion.* The compared incidence of adverse perioperative clinical effects and complications after administration of hyperbaric lidocaine and bupivacaine in spinal anesthesia was not statistically significant.

Key words: *spinal anesthesia, lidocaine, bupivacaine, perioperative complications*.

Introduction

Spinal anesthesia, which is usually achieved with various local anesthetics, is a commonly used method during surgical intervention. Example of local anesthetics, which are used in everyday surgical practice, are bupivacaine and lidocaine. Complications which may occur under spinal anesthesia range from mild to severe and may occur perioperatively or postoperatively. Moreover, the use of local anesthetics in spinal anesthesia can cause various side effects and complications in the perioperative period such as hypotension, bradycardia, tremor, pruritus, nausea, vomiting, hearing impairment, insufficient anesthesia, paresthesia, spinal cord ischemia, total spinal anesthesia, spinal hematoma, headache, cauda equina syndrome, allergy,

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unilateral block, and even death (1, 2). Before using spinal anesthesia, it is important to choose the appropriate local anesthetic with dose that will later have a sufficient effect in all the necessary parameters and provide satisfaction for the patient, surgeon and anesthesiologist.

Side effects (psychogenic, toxic, immunological and specific) during spinal anesthesia may be affected by different factors such as overdose, technical errors, allergies, hypersensitivity, needle type, anesthetic concentration, weight and height of the patient and the patient's position on the operating table (3). In addition, additives added to the anesthetics may also cause side effects (4). Vasoconstrictors can cause cardiovascular disorders (5), while prilocaine may cause methaemoglobinaemia. Therefore, preoperative preparation and assessment play an important role in the course and outcome of neuroaxial anesthesia.

In our study, we compared and presented side effects and complications that occurred perioperatively during spinal anesthesia in our patients after administration of hyperbaric lidocaine and bupivacaine.

Since the use of neuroaxial anesthesia in clinical practice is on the rise, anesthesiologists are primarily focused on identifying possible complications and side effects that may occur during the use of this anesthetic modality. Therefore, the aim of this study was to investigate complications and effects of neuroaxial anesthesia, which were caused by local anesthetics (hyperbaric lidocaine and bupivacaine).

Methods

The study was retrospective and included 178 patients of both sexes, operated at the Clinical Center in Sarajevo and at the General Hospital Mostar in the period from 30.08. 1993 to 12.12. 1995. The source of data is the book of records of anesthetized patients. Patients were divided into two groups. Group I (n-98) are patients in whom heavy form of 5% Lidocaine was used for spinal block. Patients in Group II (n-80) were divided into two subgroups in which heavy bupivacaine was used. Subgroup A received Marcain 0.5%, while subgroup B received Sensorcain 0.75%. In the study, we analyzed gender, age, side effects, complications, and adequacy of spinal block. The same anesthesiologist under sterile conditions performed the spinal technique of spinal block procedure. The adequately initiated block was controlled by the technique of light pricking with a sterile needle. In Group I, pain control and loss of sensibility in all dermatomes below Th10 was determined 2-6 minutes after lidocaine administration, and in Group II, 6 to 15 minutes after bupivacaine administration. The application of local anesthetic was performed in all patients in a sitting position at the lumbar level L2 / 3, L3 / 4, and L4 / 5 of the spine by using Quincke-type spinal needles of 22-25G. For accessing the spinal space, we used medial approach through the interspinous ligament. Lateral access to the spinal space was used because of pronounced calcification of the interspinous ligament. The study included all of the patients who received neuroaxial anesthesia, and in which spinal blockade could secure the conditions for surgical anesthesia. Each patient gave verbal informed consent for the procedure. Surgical procedures included operations on the lower abdomen and lower extremities. After placement of the spinal block, vital parameters were continuously monitored. Furthermore, we used non-invasive blood pressure monitoring every 3 minutes with constant communication with the patient. The patients were continuously monitored from the moment of anesthetic application in order to be able to adequately intervene in the occurrence of any adverse reaction. The occurrence of hypotension with a drop in systolic pressure below 80 mmHg was managed by injection of Ephedrine plus infusion therapy, usually with crystalloids. Bradycardia below 50 beats per minutes with a tendency for further decrease was addressed with 0.5 mg of i.v. Atropine. For the treatment of shivering, we used 5 mg of i.v. Diazepam with heating of infusion solutions. Conversion of insufficient or absent spinal block was resolved with ketamine or general balanced anesthesia. In the case of nasal itching, we used manual cutaneous stimulation of the nasal region with gauze, which gave satisfactory results. The internal Ethics Committee approved the study.

We analyzed the results statistically. The values were expressed as the mean value ± SD. Statistical analysis was carried out using Student's t-test. The value of $p<0.05$ was considered statistically significant. To compare the incidence of adverse events between groups, we used the MedCalc Software system with comparison of two rates. For the confidence interval of the difference between two rates, we used the option of "Test based Method" within the MedCalc software, while the P-value was obtained by using the Chi^2-statistic. For the confidence interval of the incidence rate ratio within MedCalc, we used the "Exact Poisson

Method". The P-value is the exact mid-P double sided P-value. If the p < 0.05 then it was considered that, there is a statistical significant difference between the two rates.

Results

The study included 178 patients of both sexes (30 females, 148 males) divided into two groups. In Group I (n-98), there were 79 male and 19 female patients. In Group II (n-80), there were 69 male and 11 female patients. In Group II, subgroup A, 43 male and 8 female patients received Marcaine 0.5%, and in subgroup B, 26 male and 3 female patients received Sensorcaine 0.75%.

The mean age of patients in the Group I was 44.96 and in Group II 48.16 years. In Group I the youngest patient was 17 years old and the oldest 85, while in Group II the youngest patient was 15 while the oldest was 87 years old. There was no statistically significant difference in the age of patients from both groups as p> 0.05 (p=0.2321).

The occurrence of satisfactory spinal block was significantly faster in Group I in the period of 3.86 min on average when compared to Group II result of 9.50 min (p <0.0001). By comparing the occurrence of satisfactory spinal block in subgroups A (8.68min) and B (9.98min), the difference was considered very statistically significant (p <0.005).

In Group I, each of the 83 patients received 2ml, 1 patient had 2.5ml, 13 patients received 3ml, while 1 patient was injected with 4ml of hyperbaric Lidocaine 5%. Among patients with complications, one received 3ml of anesthetic while all others received 2ml of anesthetic.

In Group II, subgroup A (n-51) patients received hyperbaric bupivacaine, Marcain 0.5%, while in subgroup B (n-29) patients received hyperbaric Sensorcaine 0.75%. In subgroup A, each of the 30 patients received 3ml, 4 patients received 3.5ml while 17 patients were injected with 4ml of 0.5% Marcaine. In subgroup B, each of 28 patients received 2ml and 1 patient received 1.5ml 0.75% Sensorcaine.

In Group I, 3 (3.06%) patients underwent conversion of the block to general anesthesia due to insufficient analgesia. These patients received 2ml of hyperbaric Lidocaine 5% for spinal block. One patient who received 3 ml of anesthetic developed aphasia, chest pain, cyanosis, bradycardia, and hypotension at the beginning of anesthesia. At the end of the operation, which lasted 90 minutes, 1 patient developed serious hypotension and bradycardia. In 2 (2.04%) patients due to unexpected premature pain of VAS score 4, we decided to administer fractioned fentanyl per 50μgr in one and 1% of lidocaine topically in other case.

Tremor occurred in 2 (2.04%) patients who received 2 ml of anesthetic whereas in another 2 (2.04%) patients bradycardia and hypotension occurred at the beginning of anesthesia. Nasal itching occurred in 14 (14.2%) patients.

In Group II, subgroup A, tremor occurred in 4 (7.84%), bradycardia in 3 (5.88%), and hypotension in 3 (5.88%) patients while nasal itching occurred in 3 (5.88%) patients. In subgroup B, hypotension and bradycardia occurred in 2 (6.89%) patients. Conversion to general anesthesia was performed in 2 (6.89%) patients, where first patient due to insufficient block received 2ml of 0.75% Sensorcaine, while the second patient (18-year-old with psychomotor restlessness) received 1.5ml of 0.75%Sensorcaine. Nasal itching occurred in only 1 patient (3.44%).

Clinically in Group I, complications and adverse reactions occurred in 25 (25.51%) patients. In Group II, adverse reactions and clinical complications in the observed perioperative period occurred in 18 (22.50%) patients. There was no statistically significant difference between groups in the incidence rate of complications (p> 0.05) (Table 1). In addition, no significant difference was observed between the subgroups (p>0.05). In Group I, the resulting complications had a more severe clinical picture.

Table 1 It shows the results of a comparison of two incidence rates of complications between the observed groups.

Comparison of two rates	Results
Group 1 Incidence rate	0.2551
95% Confidence Interval	0.1651 to 0.3766
Group 2 Incidence rate	0.225
95% Confidence Interval	0.1333 to 0.3556
Incidence rate difference	0.0301
95% Confidence Interval	-0.11505 to 0.17525
P-value	P = 0.6844
Incidence rate ratio	1.1338
95% Confidence Interval	0.5942 to 2.2058
P-value	P = 0.6914

Discussion

For adequate neuroaxial anesthesia, it is important to choose an appropriate local anesthetic that will have a sufficient effect in all the necessary parameters and which will provide satisfaction to the patient, surgeon and anesthesiologist. In this regard, lidocaine and bupivacaine are commonly used anesthetics. Due to its long action, bupivacaine has proven to be a suitable anesthetic in spinal anesthesia, especially for operations that last longer. In our study, we processed all spinal anesthetic procedures, which were performed during the examined period.

Most complications occur in the first half an hour of spinal blockade. Verbal communication during this period with the patient can be useful in stimulating the sympathetic nervous system and reducing the occurrence of some side effects. Continuous oxygenation is a regular therapeutic measure with an orinasal mask or nasal catheter. In severe complications in a patient with the appearance of circulatory collapse, aphasia, cyanosis and bradycardia, intensive resuscitation gave a positive result with improvement of the condition. The occurrence of hypotension, bradycardia and nausea at the end of the operation, which we had in our sample, is a rare occurrence in spinal anesthesia, but it is much more pronounced in intensity if it takes place at the end of surgery, which requires a serious approach in the management of this condition. In our work, we noticed that hyperbaric Lidocaine 5% gives somewhat more severe clinical complications when compared to hyperbaric bupivacaine. All our patients, despite the side effects and clinical complications, left the operating room in a stable condition.

The constant dilemma of which type of anesthesia to choose has led to a series of studies that have addressed this problem. Thus, a multicenter study by Neuman et al, in 46 hospitals in the USA and Canada, compared spinal and general anesthesia in 1,600 patients, of whom 795 received spinal anesthesia and 805 general anesthesia for hip fracture surgery. In this study, spinal anesthesia did not demonstrated to be superior to general in terms of recovery, mobilization, and mortality (6).

In a study by Fawzy et al. out of 149 patients, 124 were satisfied with spinal anesthesia and would recommend it to other patients while only five patients were dissatisfied (7).

A study by Teunkens et al, which compared chlorprocaine, bupivacaine, and lidocaine, found that the compared groups did not differ in patient satisfaction, incidence of bradycardia, hypotension, and rate of transient neurological symptoms (8).

Many causative factors can influence the occurrence of complications during spinal anesthesia. Hampl et al. in a prospective study assessed whether hyperbaric lidocaine could contribute to transient neurological complications by comparing concentrations of 5% lidocaine with 7.5% dextrose, 0.5% bupivacaine with 8.25% dextrose, and 5% lidocaine with 2.7% dextrose. They showed no difference in symptoms between 2 different osmolality of lidocaine, with the incidence of neurological complications being 33.3% with lidocaine in 7.5% dextrose and 30.8% with lidocaine in 2.7% dextrose, compared with 0% in the bupivacaine group. The average duration of symptoms ranged from 1.2 to 1.4 days (9).

Transient neurological complications are a significant problem in patients who have spinal anesthesia with hyperbaric lidocaine compared to hyperbaric bupivacaine, administered in the supine position. In daily surgeries, neurological complications would begin after the patient is discharged from the hospital. The use of hyperbaric lidocaine is therefore questionable, although these problems are almost all milder in intensity, so most patients would still choose spinal anesthesia for future surgery (10).

In one study, experimental data showed lower neurotoxic potential for ropivacaine compared to levobupivacaine, procaine and bupivacaine. The addition of epinephrine has not been shown to increase the neurotoxicity of lidocaine. In vivo experimental data indicate that the neurotoxicity of lidocaine and bupivacaine is not enhanced in patients with diabetes (11).

Comparing the effects of lidocaine and bupivacaine, Pradhan concluded in his study that the effects of these anesthetics were similar in terms of sensory and motor effects and intraoperative hemodynamic changes such as hypotension and bradycardia, and other complications such as cesarean section tremor (12).

Although neuroaxial anesthesia is increasingly used in clinical practice, it is necessary to continue research on possible complications, especially when it comes to new anesthetics and their combinations, as well as the effect of anesthetics on various comorbidities and other clinical parameters relevant to the anesthesia outcome in studies with a larger number of samples.

Conclusion

The compared incidence of adverse perioperative clinical effects and complications after administration of hyperbaric lidocaine and bupivacaine in spinal anesthesia was not statistically significant. Hyperbaric Lidocaine of 5% in contrast to hyperbaric Bupivacaine of 0.5% and 0.75% causes a greater number of perioperative complications with a potentially more severe clinical picture. Bupivacaine has been shown to be a safer anesthetic in our clinical study for spinal anesthesia. Early detection and timely diagnosis with adequate treatment contribute to the reduction of severe complications that can lead to morbidity and mortality.

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Sažetak

KLINIČKI EFEKTI HIPERBARNOG LIDOKAINA I BUPIVAKAINA U SPINALNOJ ANESTEZIJI – NAŠA ISKUSTVA

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Uvod. Primjenom bupivakaina i lidokaina mogu nastati različiti neželjeni efekti i komplikacije u perioperativnom periodu. *Cilj.* Komparativni prikaz pojave neželjenih kliničkih efekta i komplikacija hiperbarnog lidokaina i bupivakaina u toku spinalne anestezije kod naših pacijenata. *Metode*. Studija je retrospektivna i obuhvatila je 178 pacijenata oba spola. Pacijenti su podjeljeni u dvije grupe. U Grupi I (n-98) za spinalni blok korišten hiperbarni lidocain 5%. Grupa II (n-80) je podjeljena u 2 podgrupe, A- gdje je korišten hiperbarni Markain 0.5% (n-51) i B (n-29) gdje je korišten Sensorkain 0.75%. U studiji smo analizirali spol, dob, početak bloka i nastale komplikacije. *Rezultati.* U Grupi I bilo je 98 pacijenata, 79 muškog spola i 19 ženskog spola. U Grupi II je bilo 80 pacijenata, 69 muškog spola i 11 ženskog spola. Prosječna dob pacijenata u Grupi I je iznosila 44,96, a u Grupi II 48,16 godina. Nema statistički signifikantne razlike u dobi pacijenata u obe grupe $p>0.05$ ($p>0.2321$). Pojava spinalnog bloka je znatno brže nastajala u Grupi I u odnosu na grupu II ($p<0.0001$), a u podgrupi B brže u odnosu na podgrupu A ($p<0.005$). Klinička pojava komplikacija i neželjenih efekata u toku spinalne anestezije je nešto češća kod spinalnog bloka sa lidokainom 5%. *Zaključak*. Poređena incidenca neželjenih perioperativnih kliničkih efekata i komplikacija nakon primjenjenog hiperbarnog lidokaina i bupivakaina u spinalnoj anesteziji nije bila statistički signifikantna.

Ključne riječi: *spinalna anestezija, lidokain, bupivakain, perioperativne komplikacije.*