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Preemptive Wound Infiltration in Lumbar Laminectomy for Postoperative Pain: Comparison of Bupivacaine and Levobupivacaine

Lomber Laminektomi Sonrası Postoperatif Ağrı Tedavisinde Preemptif Yara Yeri İnfiltrasyonu: Bupivakain ve Levobupivakain'in Karşılaştırılması

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ABSTRACT

AIM: Patients usually suffer significant pain after lumbar laminectomy. Wound infiltration with local anesthetics is a useful method for postoperative pain control. Our aim was to compare the efficacies of preemptive wound infiltration with bupivacaine and levobupivacaine.

MATERIAL and METHODS: 60 patients were randomized three groups as follows: Group L wound infiltration with 20 mL 0.25% levobupivacaine and 40 mg methylprednisolone just before wound closure; Group B wound infiltration with 20 mL 0.25% bupivacaine and 40 mg methylprednisolone before closure; Group C had this region infiltrated with 20 ml physiological saline. Demographic data, vital signs, postoperative pain scores and morphine usage were recorded.

RESULTS: First analgesic requirement time was significantly shorter in the control group compared to other two groups ($p<0.001$). Group B had the lowest cumulative morphine consumption at the end of 24 hours within 0-4, 4-12 and 12-24 hours time intervals and the values were not significant when compared with Group L, however the consumption of both groups was significantly lower compared to the control group ($p<0.001$).

CONCLUSION: Our data suggest that preoperative infiltration of the wound site with bupivacaine or levobupivacaine provides similarly effective pain control with reduced opiate dose after unilateral lumbar laminectomy.

KEYWORDS: Lumbar laminectomy, Bupivacaine, Levobupivacaine, Postoperative pain

ÖZ

AMAÇ: Hastalar lomber laminektomi sonrası şiddetli ağrı çekebilirler. Lokal anestezik ile yara infiltrasyonu postoperatif ağrı kontrolü için yararlı bir yöntemdir. Bu çalışmada, bupivakain ve levobupivakain ile yara infiltrasyonunun etkinliklerinin karşılaştırılması amaçlanmıştır.

YÖNTEM ve GEREÇLER: 60 hasta randomize edilerek üç gruba ayrıldı: B grubu 20 ml %0,25 bupivakain ve 40 mg metilprednizolon ile kapatma öncesi yara infiltrasyonu; L grubu 20 ml %0,25 levobupivakain ve 40 mg metilprednizolon ile kapatma öncesi yara infiltrasyonu ve C Grubu 20 ml serum fizyolojik ile kapatma öncesi yara infiltrasyonu. Demografik veriler, vital bulgular, postoperatif ağrı skorları ve morfin kullanımı kaydedildi.

BULGULAR: İlk analjezik istem zamanı kontrol grubunda diğer iki gruba göre daha kısa bulundu($p <0,001$). 0-4, 4-12, 12-24 saatlik dilimlerde ve 24 saat sonunda en düşük toplam morfin tüketimi B grubunda tespit edildi ve grup L ile karşılaştırıldığında anlamlı farklılık saptanmadı. Ancak her iki grupta da morfin tüketiminin kontrol grubuna göre önemli ölçüde daha düşük olduğu bulundu($p <0,001$).

SONUÇ: Verilerimiz bupivakain veya levobupivakain ile yara yerinin ameliyat öncesi infiltrasyonunun tek taraflı lomber laminektomi sonrası benzer etkin ağrı kontrolü sağladığını göstermektedir.

ANAHTAR SÖZCÜKLER: Lomber laminektomi, Bupivakain, Levobupivakain, Postoperatif ağrı

INTRODUCTION

Severe postoperative pain can be occurred in patients who have lumbar disc herniation (LDH) operations especially on the surgery site after the operation. There are several post-operative pain control methods in order to reduce this pain. Among them, intermittent intravenous, intramuscular injections and patient-controlled analgesia are in the lead. However, these methods are mostly insufficient in pain control, since they are used after the pain has developed and fluctuations will arise in the blood concentration of analgesic substance in case of intermittent administration. Furthermore, these methods are generally insufficient to reduce pain arising

from movement as well. Such an insufficient post-operative pain control may result in complications and delay discharge from hospital. Post-operative pain may pose negative effects on pulmonary and cardiovascular system regardless of its severity (17,10,9). Besides, the risk of thromboembolism increases and intestinal motility slows down when early mobilization cannot be performed. Efficient post-operative analgesia is related to lower mortality and morbidity, in this way the hospitalization time also decreases (19,20).

Wound site infiltration is the simplest and most efficient method in acute post-operative pain management, but it is rarely applied due to the risk of wound site infection. It has been reported that pre-operative (pre-emptive) local anesthetics injection applied to the incision site are very effective in reducing pain arising both when resting and moving (16,5,8). For the surrounding of wound, long-term effective local anesthetics infiltration may provide efficient analgesia. The most preferred local anesthetic is bupivacaine. In recent years levobupivacaine which is bupivacaine S(-) enantiomer and lower cardiotoxic effect has also started to be commonly used in local anesthesia. The use of levobupivacaine as dose and concentration in clinics is in the same way with bupivacaine. Levobupivacaine has lower risk for cardiovascular system and lower toxicity for central nervous system (6). Moreover, the injection of corticosteroids inhibits inflammatory mediators that play role in pain formation, so prevents the release of neuropeptides stimulating nerve fibers (4).

We previously performed 2 different studies (5,8) showing the effect of bupivacaine + corticosteroid and levobupivacaine + corticosteroid injection on post-operative pain control in lumbar laminectomy. In this study, we aimed to compare the efficiency of bupivacaine and levobupivacaine on infiltration analgesia in lumbar disc surgery and to determine the most convenient anesthetic agent in terms of side effects.

MATERIAL and METHODS

The study was conducted as double-blinded, randomized and prospective after faculty ethic committee permission (03.03.2009, 209-3/13). 60 patients between the age 18-65, ASA I – II who were planned to have single distance – single site lumbar disc surgery and did not have prior lumbar disc story were included in the study which was planned as randomized and double blind. Patients who undergo instrumentation due to spondylolisthesis or spinal stenosis, have ASA III-IV status, have known local anesthetics allergy and are planned to have multiple distance or double site laminectomy were excluded from the study.

Randomization was performed through the closed envelope method and patients were divided into 3 groups:

Group L: 10 ml %0.5 levobupivacaine + 40 mg depomedrol + 9 ml physiological saline

Group B: 10 ml %0.5 bupivacaine + 40 mg depomedrol + 9 ml physiological saline

Group C (Control): 20 ml serum physiologic

Patients included in the study were informed about the use of patient-controlled analgesia (PCA) in the operation room and afterwards monitorization was used for the patients with non-invasive blood pressure monitoring, electrocardiography (ECG), and peripheral oxygen saturation follow-up (Sp02). All patients were administered sedation of 0.03 mg / kg midazolam before general anesthesia. Afterwards, general anesthesia induction was performed with 2 mcg/kg fentanyl, 3 mg/kg propofol and muscle relaxation was ensured with 0.6 mg/kg rocuronium. Following the endotracheal intubation, general anesthesia was maintained with 2-2.5 % sevoflurane in 40/60 O2/N2O and additional doses of fentanyl and rocuronium when necessary.

After giving position for surgery, a local anesthetic solution prepared by an anesthetist independent from the study was given to the surgeon; infiltration anesthesia was applied to the surgery site paravertebral muscles (musculus multifidi) before incision. Subsequently, the surgical procedure was applied, and patients were extubated at the end of surgery and transferred to the recovery room. In the recovery room, PCA was started to each patient and set to 2 mg bolus with 10-minute lock out period and 24 mg of 4-hour limit. Pain, potential complications and vital functions were evaluated in recovery room and patients who matched the discharge criteria were sent to the clinic.

The mean arterial blood pressure (MAP), heart rates (HR) and SpO2 were recorded before general anesthesia, after induction, at 10^{th}, 30^{th}, 45^{th}, 60^{th}, and 90^{th} minutes of the operation, at 5^{th}, 10^{th}, 15^{th} and 30^{th} minutes in recovery room, at 1^{st}, 2^{nd}, 4^{th}, 8^{th}, 12^{th}, 16^{th} and 24^{th} hours in clinic. Additionally, Ramsay sedation scores (18) (RSS; 1: anxiety and agitated, 2: cooperated, oriented and silent, 3: can fulfill simple orders, 4: live response to mild stimulus applied to glabella and to stimulus with high volume, 5: slower response to the stimulus above, 6: no response to the stimulus above) and visual analogous scale (VAS; 0: no pain, 10: most severe pain that imaginable), pain scores with movement (VAS_M) and rest (VAS_R) were recorded in post-operative period in the clinic at same time intervals. The first analgesic requirement times, morphine consumption within 0-4, 4-12 and 12-24 time intervals, cumulative morphine consumption at the end of 24 hours were recorded. When VAS was >4, 20 mg i.m. diclofenac sodium was administered in case of a need for additional analgesic.

Statistical analyses were carried out with SPSS 13.0. The authors estimated there was 0.85 probability (in SD) that a patient who received a local injection of bupivacaine or levobupivacaine would report lower pain intensity on VAS scoring than a patient who received a local injection of saline solution regarding our past studies (5,8). Student-t test and unidirectional variance analysis test were used in the calculation of average values and standard deviations. Independent variables and continuous measurements were evaluated with Kruskal-Wallis, Chi-square test and Mann-Whitney U test. The value of $p<0.05$ was accepted as statistically important difference.

Table I: Demographic Data of the Patients and Operation Times

	Group B (n=18)	Group L (n=19)	Group C (n=19)
Age	42.2 ± 2.8	43.2 ± 2.9	40.4 ± 2.5
Gender (F/M)	10/8	8/11	8/11
Height (cm)	170 ± 6.1	165 ± 8.6	172 ± 5.6
Weight (kg)	73.1 ± 2.7	69.9 ± 2.3	73.7 ± 2.8
ASA I/II	14 / 4	13 / 6	15 / 4
Operation time	104.2 ± 27.2	101.4 ± 25.4	98.4 ± 31.2

Data were given as mean±SD or n.

Table II: Results for Time to First Analgesic Requirements and Morphine Consumptions

	Group B (n=18)	Group L (n=19)	Group C (n=19)
First analgesic requirement	56.3±17.8	53.3±15.9	32.6±14.7*
Mean cumulative morphine (0-4 hr)	3.4±1.1	3.8±1.3	6.7±2.0*
Mean cumulative morphine (4-12 hr)	6.1±1.7	6.5±1.8	9.6±2.2*
Mean cumulative morphine (12-24 hr)	9.4±1.9	9.9±2.1	14.7±2.5*
Total morphine consumption	18.3±3.1	19.6±3.4	30.3±5.6*

Data were given as mean±SD
p<0.001, compared to Group B and L.

Table III: VAS_M and VAS_R Scores after Surgery

	Group B	Group L	Group C
VAS_M at 1 hr	2.2±0.6	2.4±0.5	4.9±1.3*
VAS_M at 2 hr	1.8±0.8	2±0.9	4.5±1.7*
VAS_M at 4 hr	1.3±0.7	1.6±0.8	3.2±1.4*
VAS_M at 8 hr	0.9±0.5	1.1±0.5	1.7±0.9
VAS_M at 12 hr	0.8±0.5	0.9±0.6	1.1±0.6
VAS_M at 24 hr	0.2±0.2	0	0.4±0.3
VAS_R at 1 hr	2.2±0.6	2.4±0.5	4.9±1.3*
VAS_R at 2 hr	1.8±0.8	2±0.9	4.5±1.7*
VAS_R at 4 hr	1.3±0.8	1.6±0.8	1.9±1.1
VAS_R at 8 hr	0.9±0.6	1.1±0.7	1.3±0.7
VAS_R at 12 hr	0.8±0.6	0.9±0.6	0.8±0.4
VAS_R at 24 hr	0.2±0.1	0	0.4±0.3

Data were given as mean±SD.
p<0.001, compared to Group B and L.

RESULTS

60 patients were included in the study. However, 2 patients one from Group L, one from Group C and 2 patients from Group B were excluded due to the complications related to PCA machine. No difference was observed between demographical data (age, gender, length, and weight), operation times and ASA classifications of patients (Table I).

HR, MAP and SpO2 parameters recorded during operation, recovery room and clinical follow-ups were found similar between groups.

The first time of requirement for analgesic was significantly shorter in the control group compared to other two groups (p<0.001). When morphine consumption was evaluated, Group B had the lowest cumulative morphine consumption at the end of 24 hours within 0-4, 4-12 and 12-24 hours time intervals and the values were not significant when compared with Group L, however the consumption of both groups was significantly lower compared to the control group (p<0.001) (Table II).

When post-operative VAS_M values were evaluated, it was determined that the scores of control group at 1st, 2nd, and 4th hours were statistically and significantly higher when compared to other two groups, similarly VAS_R values were also determined to be statistically and significantly higher at 1st and 2nd hours in the control group when compared to other two groups (p<0.001 in both groups). Four patients from Group C were required additional analgesic and found statistically significant (p<0.05) (Table III).

No difference was observed between post-operative RAMSAY sedation scores and the average value was determined as 2 for each patient. 2 patients from Group B and 2 patients from Group L had nausea and i.v. metoclopramide was administered.

DISCUSSION

In our study, bupivacaine – methylprednisolone and levobupivacaine – methylprednisolone groups were different from the control group in terms of many parameters. Lower consumption of analgesics, lower increase in average arterial blood pressure, and additional analgesic requirement were detected as lower compared to the control group.

The efficiency of infiltrative local analgesic administration on post-operative analgesia depends on many factors. These can be summarized as the type of surgical intervention, selected local anesthetic agent, local anesthetic concentration, its volume, application time and tissue layers to be injected. By taking these into consideration, we performed this study with patients taken to the operation by the same surgeon and with the same operational technique. Due to the traditional information that 0.5 % bupivacaine can provide efficient post-operative analgesia in minor and moderate surgeries, the concentrations of agents used in the study were determined as 0.5 %. In previous studies, the fact whether the peritoneum is harmed during surgery in moderate and big surgical interventions was reported as decisive for post-operative pain. Lumbar laminectomy operations are advantageous surgical interventions for post-operative pain treatment since there is no peritoneum harm.

There are many studies reporting successive results especially with local anesthetics used in wound site infiltration. These studies were performed in different concentrations and volumes to different tissue layers and with different methods. Meena et.al. (15) administered 0.25 % bupivacaine to wound site via infiltration in lumbar laminectomy operations and observed that it was not more effective than the placebo group in terms of post-operative analgesia. Moreover, the analgesic requirement was even lower only within the first post-operative 2 hours. In addition to this, they reported that bupivacaine used in concentration of 0.375 % provided analgesia in all patients within post-operative 9 hours. In this study, there was no analgesic requirement in only 18 % of the patients (5/24) within post-operative 24 hours. Mack et al. (14) claimed that local anesthetic or steroid infiltration alone does not reduce post-operative pain and opioid requirement in patients who have lumbar laminectomy through microsurgery. They injected 0.25 % bupivacaine in 15 ml volume to i.v. cetolorac and paraspinal muscles on wound site in their study. Yorukoglu et al. (21) compared the infiltration of bupivacaine onto wound site for pain control in lumbar disc operations with intrathecal and epidural morphine in low dose and found out that the meperidine requirement was lower within the post-operative first 6 hours in morphine group and the meperidine requirement within the first 24 hours was similar in all groups. The fact that additional analgesic requirement was present in the control group (20 %) showed us a treatment option with lower cost can be obtained by increasing the analgesia to first 24 hours with i.v. PCA. The need for morphine was lower in bupivacaine – methylprednisolone group among all groups. In comparison with our previous applications where we analyzed the efficiency of local wound infiltration and 0.25 % bupivacaine or bupivacaine steroid combination to stop the pain in surgical site after laminectomy operation, we observed that 0.5 % bupivacaine – methyl prednisolone was more efficient. It is obvious that the total consumption will decrease by increasing the analgesic concentration.

In their study on 32 patients, Glasser et al. (7) injected 30 mL of 0.25% bupivacaine into the paravertebral muscles and under the skin before and after the surgery subsequent to 250 mg IV Depo-Medrol® (methylprednisolone sodium succinate) and 160 mg Depo-Medrol® (methylprednisolone acetate) administration to the first group and they placed autologous fat graft soaked with 80 mg methylprednisolone on to the affected nerve. They only administered 30 mL of 0.25% bupivacaine to the paravertebral muscles and the tissue under the skin of the second group before and after the surgery and injected 10 mL of 0.5% lidocaine to the tissue under the skin of the control group before the skin incision. They evaluated the post-operative pain scores of patients from the study group and subjects from the control group taking placebo at 24 hours, one week and one-month time intervals in the post-operative period. At the end of the post-operative 24 hours, they achieved 44% complete palliation in patients taking systemic corticosteroids and local bupivacaine and 14% in patients taking only bupivacaine, whereas no palliation could be achieved in the patients taking a placebo. At the end of one month, no significant difference was detected between the groups. However, they observed a higher patient satisfaction in the patients administered with corticosteroid-bupivacaine combination. On the contrary, in our study we achieved nearly 100% pain management at the end of 24 hours by administering a lower dose of steroid (40 mg) only to the wound site without using systemic steroids. Thus, we prevented the possible side effects that may arise due to steroid use.

In their study with 50 patients, Chadduk et al. (3) placed autologous fat tissue containing 40 mg methyl prednisolone to the wound site after administering 40 mL saline or 0.25% bupivacaine to the paravertebral muscles during wound closure and they did not detect a significant difference in the pain schedules of patients evaluated with 10-cm Visual Analog Scale (VAS) and four-point pain scales at 3, 12, and 24 hours. The fact that methylprednisolone was administered to the subjects from the control group gives rise to the thought that administering steroids to the epidural area plays a key role in the management of post-operative pain.

The additional opioids needed by the patients in post-operative period have an important role in evaluating the efficacy of the analgesic methods. Determined for the first time in 1968 in the literature and the subject of many studies, PCA is administered via several routes such as intramuscular, epidural, subcutaneous and rectal routes (2). The parameters obtained with PCA enable a more objective evaluation. In our study, we administered IV PCA morphine, which is less invasive and more easily monitored, and recorded the opioid consumption for 24 hours. We observed that the post-operative cumulative morphine doses were lower in all patients taking the study solution compared to the ones taking the placebo and this difference was statistically significant.

Glasser et al. (7) evaluated the effect of bupivacaine application to the incision site on post-operative analgesic consumption after surgery when no bupivacaine-corticosteroid and systemic corticosteroid were given to the incision site of patients taking systemic post-operative corticosteroid at the end of lumbar disk surgery. Researchers reported that they could ensure palliation of pain with a lower amount of injectable opioids in patients on whom they applied bupivacaine-corticosteroid combination, and they concluded that this was an effect of both systemically and locally applied corticosteroids.

In their study on 88 patients to whom they performed cervical laminectomy, King et al. (11) compared the analgesic requirements of patients and the control group for three days in the post-operative period after administering 10 mg IV dexamethasone in the pre-operative period and 4 mg IM for three days in the post-operative period to the study group. They observed that the post-operative narcotic consumption was lower in the study group, including patients having lumbar laminectomy, and indicated that administering systemic steroids in the pre-operative period and during the first 72 hours in the post-operative period was useful in post-operative pain management. Chadduck et al. (3) found that morphine consumption was similar between patients taking local anesthetics and placebo, whereas it was lower in the group of patients taking corticosteroid medication in their study where they analyzed the efficacy of bupivacaine and methylprednisolone on post-operative analgesia after lumbar decompression. They also emphasized that methylprednisolone has an active role in post-operative analgesia. Mirzai et al. (16) compared the efficacy of peri-operative corticosteroid-bupivacaine combination and placebo on low back pain in lumbar disc surgery and observed that the post-operative meperidine requirement was obviously lower in the study group compared to the control group. As a result of our study, we came to the conclusion that applying local anesthetics and steroids to the incision site without using a systemic steroid may be sufficient in decreasing post-operative additional opioid analgesic consumption.

Local anesthesia agents have a wide range of application area for reducing incisional pains in several surgical operations. In most of these studies, levobupivacaine was used for the purpose of post-operative analgesia through epidural administration.

Louizos et al. (13) reported that local wound site infiltration and 0.25 % intraperitoneal levobupivacaine combination were advantageous in preventing the pain arising after laparoscopic cholecystectomy. Bay-Nielsen et al. (1) detected intra-operative pain at a rate of 36% and 21% in the 0.25 % levobupivacaine they used for infiltrative anesthesia application in inguinal hernia repair operations and 0.25% bupivacaine groups respectively, and observed bradycardia which they related to spermatic cord manipulation in one patient from both groups. When the potential complication related to different methods (catheter applications) used for post-operative pain management and the potential side effects related to drugs (opioids, NSAIDs etc.) were taken into consideration, we believe that wound site infiltration is the safest and most comfortable method for the patient. Kundra et al. (12) reported that opioids provide better analgesia with IV PCA method, but this method causes mechanical and human originated errors besides it is expensive. It is obvious that these methods will increase the cost.

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