

# Effect of Warm Bupivacaine on the Sensory Onset of Epidural Anaesthesia in Lower Limb Orthopaedic Surgery: A Double-Blind Randomized Clinical Trial

**Efekt zahřátého Bupivacainu na nástup znecitlivění při epidurální anestezi v chirurgii dolních končetin: dvojité slepá randomizovaná klinická studie**

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## ABSTRACT

### PURPOSE OF THE STUDY

In this study we evaluated the effect of warm bupivacaine on the onset time of sensory block in patients undergoing lower limb surgery with epidural anaesthesia

### METHODS

After approval by the Ethics Committee and written informed consents, 60 ASA physical status I and II patients, aged 18 to 75 years, undergoing elective lower limb surgery were studied in this randomized double-blind clinical trial. The patients having spinal anaesthesia were divided into two groups. Group 1 received warm bupivacaine and group 2 was given bupivacaine at room temperature. The onset time and the level of sensory block were evaluated by a blind observer. Side effects (nausea, vomiting, shivering, headache, low back pain) were evaluated during surgery and in the post-operative period.

### RESULTS

One patient was excluded from the study because of incomplete block; therefore 59 patients in two groups (29 patients in group 1 and 30 patients in group 2) were compared. The groups were matched on gender, age, weight and BMI. The onset time of sensory block at the levels of T12, L3 and L4 in group 1 was significantly shorter than in group 2 ( $p < 0.001$ ). The difference in the onset time of sensory block at the upper levels of the spine between the two groups was not significant ( $p = 0.21$ ). The incidence of side effects did not differ significantly ( $p = 0.18$ ) between the two groups.

### CONCLUSIONS

Warming bupivacaine can decrease the onset time of sensory block in epidural anaesthesia without any side effects in patients undergoing lower limb orthopaedic surgery.

**Key words:** epidural anesthesia, warming, onset time, bupivacaine.

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## INTRODUCTION

Epidural anesthesia is usually used for lower limb orthopedic surgeries because of lower complications such as deep venous thrombosis and pulmonary emboli (8) relative to general anesthesia, but sometimes delayed onset time of sensory block is a disadvantage issue. The time to onset of sensory block in epidural anesthesia can be shortened by adding opioids (4, 5), bicarbonate

(1) or other adjuvants (2) to the local anesthetic drug. Also some studies suggested warming ropivacaine (15) and lidocaine (9, 14) shorten the onset of sensory block. Bupivacaine is used commonly for epidural anesthesia and in this study we evaluated the effect of warming bupivacaine on the time of onset of sensory block after epidural anesthesia.

## MATERIAL AND METHODS

After approval by the Ethical Committee and written informed consent, 60 patients were studied in this randomized double blind clinical trial study. Patients age 18–75 years old with American Society of Anesthesia (ASA) physical status I or II underwent for elective lower extremity surgery under epidural anesthesia were studied. Patients with neuropathy, cardiovascular or respiratory disease, fever, psychiatric disease, infection of injection site, coagulopathy and allergy to local anesthetic drug were excluded from the study. The patient exclude from the study if sensory block didn't reach desirable level after 45 minutes from the epidural procedure. All the patients received 500 ml of ringer solution before epidural anesthesia. The patients assigned into one of the two groups according to random-number table. In the first group warmed bupivacaine and in the second group bupivacaine in the room temperature were injected in epidural space. To warming bupivacaine and epidural set, we placed them in a warmer (persimed company) with temperature of 38 °C for 30 minutes before injecting the drug. Electrocardiograms, pulse oximetry and non-invasive blood pressure monitored during epidural procedure and surgery. In the left lateral decubitus position local anesthetic injected into the epidural space at the level of L4-L5 with using Touhy needle and loss of resistant technique. At the first, 15 µg epinephrine added to three ml of lidocaine 2% was injected as the test dose and if no signs of intravascular or subarachnoid injections were detected within 3 min, 16 ml of bupivacaine (Astrazeneca) 0.5% was injected, and then epidural catheter was inserted for control of postoperative pain. The time of onset and level of the sensory block are evaluated by a blind observer by loss of sensation to pinprick tests every 2.5 minutes after the procedure of epidural until 45 minutes after the epidural procedure. Adverse effects (hypotension, nausea, vomiting, shivering, headache, low back pain) were evaluated during the surgery and postoperative period. All data analyzed using SPSS software version 15 and statistical tests. Mann-Whitney Test was used to compare the time of onset of sensory block between two groups. The upper level of the block compared by using chi-square test. P-values < 0.05 was considered significant.

## RESULTS

One patient excluded from the study because of incomplete block, so 59 patients in two groups (29 patients in warmed group and 30 patients in non-warmed group) were compared. The patients in two groups were similar according to gender, age, weight and BMI (Table 1). The time of onset of the sensory block at the levels of T 12, L 3, L4 in warm group was significantly shorter than the other group (p-value < 0.001) (Table 2). Difference of the upper level of sensory block in two groups were not significant (p-value = 0.21) (Table 3). The incidence of adverse effects in the patients in two groups were not different significantly (p-value = 0.18).

## DISCUSSION

The methods that speeds the onset of sensory block in epidural anesthesia are mentioned in many studies. There is controversy about the alkalization of local anesthetics to speed the onset time of epidural anesthesia because of possibility of precipitation of the solution after adding bicarbonate to local anesthetic (3, 16). On the other hand administering neuraxial opioids to shorten the onset time of epidural anesthesia has potentially adverse effects such as respiratory depression (17) that limits use of these drugs.

In this study, the results showed that the time of onset of sensory block was shortened by warming bupivacaine in epidural anesthesia for lower limb orthopedic surgeries. The mechanism of the effect of warming on the onset time of sensory block in epidural anesthesia is not known exactly, but may be due to increase of non-ionized form of the drug and increased rate of passive diffusion through the cell membrane and neuronal blockade. This effect may be related to the decreases of the pKa of the drug solution due to the increase of its temperature (7).

Liu et al. (15) evaluated the effect of warming four different concentration of ropivacaine to body temperature on the onset of sensory block of epidural anesthesia at the T10, T12, L3, S4, S5 dermatomes in anal surgeries. The authors concluded warmed ropivacaine 0.75% can decrease the onset time in epidural anesthesia. Also Han et al. (9) compared the effect of warmed lidocaine (37 °C) with lidocaine at room temperature (21 °C) on the onset time of sensory block in lumbar epidural anesthesia. The investigators injected lidocaine 2% with adrenaline 1:200,000, sodium bicarbonate and fentanyl in epidural space and the results showed that warming drugs to 37 °C speeds sensory block in first sacral segment. In another study Liu et al. (8) assessed the effect of injecting warmed lidocaine without epinephrine or bicarbonate in the epidural space on the onset of sensory block in the patients undergoing anal surgeries. They concluded warming lidocaine without adding adjuvants can shorten onset time of the block.

Clark et al. (6) in a study compared the effect of plain 0.5% bupivacaine with 2% lignocaine with 1:200,000 adrenaline at either room temperature or 38 °C in four groups in the women who were candidate for Caesarean section under epidural anesthesia. The most rapid block was for warmed 2% lidocaine. Lim et al. (13) investigated the effect of prewarmed (37 °C) lidocaine 1.5% with adrenaline 1:200,000 on the latency of onset of caudal blocks. They compared the effect of lidocaine at 37 °C with room temperature (25 °C) and concluded the speed of onset of perianal analgesia was significantly faster with the prewarmed local anaesthetic solution.

All the previous studies showed that warming local anesthetic with or without epinephrine or other adjuncts speeds the onset of sensory block in the patients undergoing lumbar epidural anesthesia for obstetric or anal surgeries. Also in present study the results demonstrated warming bupivacaine can shorten the onset time of sensory block in the patients undergoing epidural anesthesia for lower limb orthopedic surgeries.

Table 1. BMI, age, gender in two groups

Age(mean)	Gender(m/f)	BMI	Variable
59.21±14.42	20/9	82.3±25	Warmed group
59.23±17.25	15/15	78.2±24	Non-warmed group
0.99	0.19	21.0	p-value

Table 2. Onset time (minutes) of sensory block at L5, L3, T12

T12	L3	L5	Variable
5.3 ± 84.12	5.3 ± 10	07.19 ± 15	Warmed group
7.5 ± 89.18	4.5 ± 08.15	6.5 ± 3.17	Non-warmed group
001.0>	001.0>	001.0>	p-value

Table 3. Level of block in two groups

Total	T <sub>7</sub>	T <sub>8</sub>	T <sub>9</sub>	T <sub>10</sub>	T <sub>11</sub>	T <sub>12</sub>	Variable
29 100%	0 0%	6 7.20%	8 6.27%	7 1.24%	7 1.24%	1 4.3%	Warmed group
30 100%	1 3.3%	2 7.6%	4 3.13%	11 7.36%	8 7.26%	4 3.13%	Nonwarmed group

*p*-value=0.21

Also warming local anesthetics in nerve blocks can reduce the onset time of both sensory and motor block. In a study (12) the investigators used warmed ropivacaine for axillary block and the results showed that warming of ropivacaine to 37 °C speeds the onset time of both sensory and motor block.

Jones et al. (10) compared the effects of warming with buffering of 0.5% bupivacaine on the time of onset of intradermal anesthesia. The results suggest that warming is more effective than buffering to reduce the time of onset of intradermal anesthesia in the volunteers.

All these studies confirmed the positive effect of warming on the onset time of the nerve blocks.

Like the effect of alkalization, warming of the local anesthetic solutions increases the non-ionized form of local anesthetics and increases their pKa and the hydrogen ions are separated from the ionized form of the drug (11), so the onset time of nerve block decreases.

In present study no serious adverse effects were seen in the patients who underwent epidural anesthesia with warmed bupivacaine. Also in the other studies no side effects were noted.

In conclusion warming bupivacaine can decrease onset time of sensory block in epidural anesthesia without any side effects in the patients undergoing lower limb orthopedic surgeries.

## CONCLUSION

Warming bupivacaine can decrease onset time of sensory block in epidural anesthesia without any side effects in the patients undergoing lower limb orthopedic surgeries.

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