Anesthesia and Postoperative Analgesia After Intra-articular Injection of Warmed Versus Room-Temperature Levobupivacaine: A Double-Blind Randomized Trial

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Purpose: This prospective, randomized, blinded study was designed to compare the effects of warmed versus room-temperature levobupivacaine in patients undergoing knee arthroscopy and partial meniscectomy. **Methods:** Patients were randomly allocated into 2 groups of 16 patients each. In all patients the 2 portal sites were infiltrated with 10 mL of room-temperature mepivacaine (20 mg/mL). In the first group, patients underwent intra-articular injection of 20 mL of levobupivacaine (5 mg/mL) and 0.005-mg/mL epinephrine (1:200,000) at a temperature of 40°C ± 0.2°C, whereas in the second group the levobupivacaine and epinephrine were at room temperature (25°C ± 0.5°C). Pain was graded and recorded intraoperatively and postoperatively by use of a visual analog scale (VAS). Analgesia was supplemented if the VAS score was 4 cm or greater with morphine intraoperatively or ketorolac postoperatively. **Results:** There were no significant differences between groups in intraoperative and postoperative VAS values. There was no need for morphine as a rescue dose in any patient during surgery. Eight patients treated with warmed levobupivacaine and seven patients treated with room-temperature levobupivacaine requested a single rescue dose of ketorolac (30 mg) postoperatively. **Conclusions:** No compelling evidence exists to suggest that intra-articular injection of warmed levobupivacaine is more effective than room-temperature levobupivacaine for intraoperative anesthesia and postoperative analgesia in patients undergoing partial meniscectomy during knee arthroscopy. **Level of Evidence:** Level I, randomized controlled trial. **Key Words:** Levobupivacaine—Intra-articular—Arthroscopy—Warm—Room temperature.

Local anesthesia for knee arthroscopy is a well-documented procedure that offers several advantages over other types of anesthesia, such as high patient satisfaction, reduced costs, narrower range of possible complications, and significantly shorter recovery time.[1,2]

Warming of local anesthetics increases their penetration into the tissue and provides a faster onset of peripheral and central nerve blocks.[3,4] Warmed lidocaine injected intra-articularly improves intraoperative anesthesia and postoperative analgesia, as compared with room-temperature lidocaine, in patients undergoing knee arthroscopy.[5] However, there are no studies involving warmed levobupivacaine in such operations.

Levobupivacaine, a new long-acting local anesthetic, is a pure left isomer of bupivacaine. Its clinical profile is similar to that of racemic bupivacaine. There are no comparative studies between the 2 drugs for arthroscopic surgery; however, in the case of epidural block, the bupivacaine-levobupivacaine potency ratio is 0.87.[6] Bupivacaine toxicity has recently been implicated in the development of chondrolysis after con-

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tinuous intra-articular infusion for arthroscopic shoulder procedures in the rabbit,[7] but no studies on the effects of levobupivacaine have been reported. On the basis of its 3-dimensional structure, levobupivacaine has less central nervous system and cardiac toxicity.[8] Accordingly, the use of levobupivacaine should be advocated when large volumes and infusion rates are required to produce an effective block; however, no complications of lidocaine toxicity were noted after continuous intra-articular infusion of a 0.2% solution of lidocaine for knee arthroscopy.[9] The relative potency of levobupivacaine is higher when compared with ropivacaine or lidocaine.[8,10]

The purpose of this study was to compare intra-articular injection of warmed versus room-temperature levobupivacaine for intraoperative anesthesia and postoperative analgesia in patients undergoing partial meniscectomy during knee arthroscopy, the hypothesis being that, as observed with lidocaine, warming induces a significant improvement in levobupivacaine's efficacy.

METHODS

The study protocol was approved by the institutional ethics committee, and written informed consent for the study was obtained from all patients. Thirty-two patients (American Society of Anesthesiologists physical status class I or II), aged 18 to 65 years, who were scheduled for elective partial meniscectomy during knee arthroscopy were investigated in a double-blind, prospective, randomized manner. We excluded patients who were unable to participate in pain assessment as per study protocol, or who were obese (body mass index >30 kg/m^2), and those with a history of drug or alcohol abuse; chronic pain; daily intake of analgesics, sedatives, or corticosteroids; or known allergic reactions to amide local anesthetics or to any of the drugs used in the study.

On arrival to the operating room, electrocardiographic electrodes were applied and oxygen saturation was measured by pulse oximetry. Blood pressure was measured noninvasively, and intravenous infusion of acetate Ringer solution was started. All patients received 0.03 mg/kg of midazolam intravenously and 30 mg of ketorolac intravenously 15 minutes before local anesthesia was induced.

Patients were randomly allocated into 2 groups of 16 patients each. Randomization was performed according to a computer-generated block-randomization schedule, by a secretary not involved in the study. In all patients the 2 portal sites were infiltrated with 10 mL of room-temperature mepivacaine (20 mg/mL). In the first group patients were assigned to receive a warmed intra-articular injection of 20 mL of levobupivacaine (5 mg/mL) and 0.005-mg/mL epinephrine (1:200,000) at a temperature of 40°C ± 0.2°C. In the second group identical volumes of levobupivacaine and epinephrine were injected intra-articularly at room temperature (25°C ± 0.5°C). The warming of the solution was performed by a nurse not involved in the study.

Levobupivacaine was first aspirated into a 20-mL syringe that was sealed in a plastic bag and then warmed by storing it in a thermostatically controlled water bath (Folabo Srl, Buccinasco, Milan, Italy) at 40°C ± 0.2°C for 1 hour before the intra-articular injection. In the second group levobupivacaine was stored at 25°C ± 0.5°C for more than 24 hours before injection.[11] The intra-articular levobupivacaine was injected by a surgeon who was not involved in the surgical procedure.

The surgeon made the incision 20 minutes after the intra-articular injection of levobupivacaine. The same surgeon performed all surgical procedures without the aid of a tourniquet. Both the attending anesthesiologists and the surgeon were blinded to patient group allocation.

Using a 10-cm visual analog scale (VAS) (where 0 is no pain and 10 is the worst imaginable pain), an independent blinded observer recorded the degree of knee pain (1) before the local anesthetic injection was administered; (2) at the time of surgical incision; (3) 10 minutes after the incision; (4) intraoperatively during manipulations of the synovium/capsule, meniscus, and cruciate ligament; and (5) at the end of surgery. For inadequate intraoperative pain relief (VAS $\geq$4 cm), rescue intravenous analgesia with 2-mg boluses of morphine was available. At the same time intervals, hemodynamic variables, respiratory frequency, oxygen saturation, and incidence of adverse events (such as nausea and vomiting) were monitored. Evaluation also included the degree of sedation (0, awake; 1, drowsy; 2, asleep but could be woken up; and 3, deep sleep, difficult to wake up).

Pain was graded and recorded postoperatively by the surgical nursing staff, who had no knowledge of the protocol, at 1, 5, and 15 hours after surgery at rest and at the time of initial mobilization (4 to 5 hours after the end of surgery). Postoperatively, analgesia was supplemented with 30 mg of ketorolac intravenously if the VAS score was 4 cm or greater.

Patient satisfaction with both intraoperative anesthesia and postoperative analgesia was evaluated at

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