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Original Contribution

A multicenter study of the analgesic effects of epidural chloroprocaine after lower limb orthopedic surgery☆

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Abstract

Study objective: To investigate the effects and optimal concentration of chloroprocaine for epidural analgesia after lower limb orthopedic surgery.

Design: Prospective, randomized, observational, multicenter clinical study.

Setting: Operating room, postoperative recovery area, university hospital.

Patients: One hundred and twenty patients from 4 hospitals were enrolled and randomized into 5 groups after lower limb orthopedic surgery under epidural anesthesia with lidocaine.

Interventions: Epidural chloroprocaine mixed with 0.4 μg/mL fentanyl was administered via a patient-controlled analgesia pump at the concentration of 0.6%, 0.8%, 1.0%, 1.2%, or 1.4% after the surgery.

Measurements: Systolic blood pressure, heart rate, visual analog score at rest and during activity, as well as the Bromage score at 0 minute, 30 minutes, 1 hour, 2 hours, 4 hours, 8 hours, 24 hours, and 48 hours after the surgery were recorded and compared. Use of morphine and incidence of adverse effects were also recorded.

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Main results: Patients given 1.2% chloroprocaine showed the lowest visual analog score compared with other groups. There was no significant difference in the Bromage score among 5 groups. The Bromage score returned to 0 in 89.7% of the patients 48 hours after surgery. No difference in postoperative morphine usage, blood pressure, or heart rate was found among 5 groups.
Conclusions: Epidural 1.2% chloroprocaine with 0.4 μg/mL fentanyl could generate proper analgesic effects with little influence on mobility in patients undergoing lower limb orthopedic surgery. In addition, it could generate a good sense and movement separation, facilitating the early functional training.

1. Introduction

It is crucial for patients who underwent orthopedic surgery to start exercise early to obtain better function recovery and reduce the incidence of postoperative complications such as deep venous thrombosis. But the postoperative pain often restrains the patients from early functional training. It has been proved that epidural analgesia is a good option to control the postoperative pain with satisfactory analgesic efficacy [1,2], although the adverse effects such as urinary retention, pruritus, and motor block should be of concern. Although peripheral nerve blocks for the most part have surpassed the use of epidurals because of their ability to provide postoperative analgesia without motor block, currently, epidural analgesia with low concentration of a long-acting local anesthetic is still widely used in clinical practice, mostly for patients who do not need anticoagulation approach postoperatively. Short-acting local anesthetic might be necessary for some special circumstance, especially when complication of epidural analgesia is suspected. In addition, combination of local anesthetic with opioids can enhance the analgesic effects and reduce the dose of single drug and the adverse effects [3-5].

Chloroprocaine is an ester local anesthetic produced by replacing the C2 of procaine with Cl. This chemical modification results in a 2-fold increase in the anesthetic effect and 4-5 times faster degradation by plasma pseudocholinesterase compared with procaine [6]. It has been widely used in nerve block and epidural anesthesia, particularly in obstetric analgesia because of its impermeability to the placenta barrier [7-9]. Its application has been expanded to subarachnoid anesthesia in some short procedures [10-12]. The fast onset time and short duration have also made it a good analgesia for postoperative pain control [13].

However, there is still a paucity of studies of epidural analgesia with chloroprocaine. For example, the dose-finding study for epidural chloroprocaine is still underused. An "optimal" concentration of epidural chloroprocaine can reduce the postoperative pain with less influence on motor activity, which will definitely facilitate the early exercise for patients who underwent orthopedic surgery. So we performed this multicenter study to investigate the effects and optimal concentration of chloroprocaine for epidural anesthesia in patients undergoing lower limb orthopedic surgery.

2. Materials and methods

This study has been approved by Sichuan University Institutional Review Board. Clinical trial registration can be found at Clinical Trial Registry, URL: http://www.chictr.org/cn/; registration number: ChiCTR-TRC-10000987. Written informed consent was obtained from each patient before recruiting into this study. Chloroprocaine was provided by Haisi Pharmco (Shanxi, Jincheng, China; 300 mg/10 mL).

A total of 120 patients with American Society of Anesthesiologists (ASA) physical status I or II were recruited from 4 Chinese medical centers including West-China Hospital of Sichuan University, People's Hospital of Peking University, Xiangya Hospital of Central-South University, and Huazhong University of Science and Technology Affiliated Tongji Hospital. The inclusion criteria were as follows: age 18-65 years, body weight ranged from 40 to 90 kg, body mass index (BMI) ranged from 18 to 28 kg/m^2, normal hepatic and renal functions, no defects of cholinesterase by history, normal coagulation function, and no contraindications for epidural anesthesia. The patients were randomly assigned to 1 of 5 groups via a computer-generated random number system. Each center received sealed consecutively numbered opaque envelopes.

All patients in this study were operated under epidural anesthesia. No analgesics were administered for each patient before the lower limb orthopedic surgery. Routine monitoring of blood pressure, electrocardiography, and oxygen saturation was started soon after the patient entered the operating room. After an intravenous line was established, epidural cannulation was performed, and a bolus of 3 mL of 2.0% lidocaine was given as a testing dose. Two percent lidocaine was administrated 15 minutes after testing dose to maintain the anesthesia during surgery. The dose and time point to give lidocaine during surgery were based on the anesthesiologist's judgment. Generally, no lidocaine was given 30 minutes before the surgery was complicated. Three mg of granisetron was given 30 minutes before the surgery was done, in order to reduce the incidence of anesthesia-induced nausea. They were then randomized into 5 groups for postoperative analgesia via a patient-controlled epidural analgesia (PCEA) pump containing chloroprocaine and fentanyl (0.4 μg/mL) in a total volume of 200 mL. The concentration of chloroprocaine in each group was 0.6%, 0.8%, 1.0%, 1.2%, and 1.4%, respectively. PCEA was started when the surgeons began to close the skin. The PCEA pump was