Low-dose ropivacaine for supraclavicular brachial plexus block combined with general anesthesia for successful postoperative analgesia: A case series

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ABSTRACT

Background: Ropivacaine, a long-acting local anesthetic agent, has been used for postoperative analgesia in brachial plexus block (BPB) at high doses. However, use of lower doses would reduce the occurrence of adverse effects. **Methods:** We applied BPB with low-dose ropivacaine (10 mL of 0.375% ropivacaine) after induction of general anesthesia for surgery of the upper extremities in 62 patients at our hospital. Ropivacaine was administered via a fluoroscopy-guided supraclavicular method. Analgesic effects during surgery, visual analog scale pain scores, skin sensation, muscle strength, and postoperative patient satisfaction indices were evaluated. **Results:** Fifty-six patients (90.3%) did not require supplemental analgesics during surgery. The remaining six patients were administered fentanyl due to the insufficient analgesic effects of the nerve block. Some adverse effects, including numbness and delayed motor and sensory recovery of the upper extremities, were observed. The mean postoperative patient-evaluated visual satisfaction scale was 94.1. **Conclusions:** Our results suggest that low-dose ropivacaine is clinically acceptable for BPB under general anesthesia.

Key words: *Ropivacaine, brachial plexus, local anesthesia, upper extremity, patient satisfaction*

INTRODUCTION

In upper extremity surgery, brachial plexus block (BPB) is performed in conjunction with general anesthesia. Ropivacaine has been used for postoperative analgesia in BPB (20-40 mL of 0.5-0.75% ropivacaine solution).[1-6] Conventional doses have been determined based on regional anesthesia use. However, lower doses of ropivacaine may permit comparable levels of BPB while reducing the occurrence of adverse effects.

We report a case series of patients undergoing upper extremity surgery under general anesthesia combined with BPB achieved by low-dose ropivacaine. To evaluate the clinical acceptability of this technique, we assessed the intraoperative analgesic effects based on hemodynamic stability, visual analog scale (VAS) scores, skin sensation, muscle strength, and postoperative patient satisfaction.

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METHODS

We enrolled 62 patients with class I and II American Society of Anesthesiologists risk classifications (mean age: 58.3±20.0 years; mean bodyweight: 54.6±14.6 kg; mean height: 158.4±11.7 cm) from a population of patients awaiting upper extremity surgery between June 2007 and October 2008. Patients who had coagulation abnormalities were excluded. The study was approved by the Nara Prefectural Mimuro Hospital Human Investigation Committee, and informed consent was obtained from all subjects.

Prior to tracheal intubation, patients were administered propofol with a target-controlled infusion (TCI) pump at a rate of 3 μg/mL, followed by intravenous fentanyl (2 μg/kg) and vecuronium (0.15 mg/kg). Following induction of anesthesia, patients received BPB with a 25-G, 60-mm blunt needle (Hakko Co., Ltd., Nagano, Japan) using the supraclavicular method.[7] The drug solution used in this

study consisted of 5 mL of 0.75% ropivacaine and 5 mL of normal saline (for a total dose of 10 mL 0.375% ropivacaine). Intraoperative maintenance of anesthesia was generally achieved with propofol (2.5-3 μg/mL; administered by the TCI pump) and vecuronium (0.06 mg/kg/h). In all cases, a tourniquet was used on the upper arm. The tourniquet was released every 90-120 min.

During surgery, adequate analgesia was defined by hemodynamic stability, as indicated by the absence of an increase in mean arterial pressure (MAP) or heart rate (HR) of more than 15% compared with baseline values recorded just before the surgical incision (a "successful case"). If HR or MAP increased by more than 15%, analgesia was considered inadequate and a supplemental dose of 50 μg fentanyl was administered every 10 min, after evaluation of HR and MAP.

Postoperative analgesics were provided as either diclofenac (suppository, 50 mg) or intravenous flurbiprofen axetil (50 mg) on the day of surgery, administered upon the patient's request. If these agents were ineffective, intramuscular pentazocine HCl (15 mg) was administered. The morning after the surgery, all patients received oral loxoprofen sodium (60 mg) after each meal (three times a day).

Subjective assessment of patient pain was made using the visual analog scale (VAS: 100 mm scale) at 2, 12 (before oral intake of loxoprofen), and 24 h after surgery and during the follow-up visit. We also recorded the time from BPB to the first administration of postoperative analgesics and recorded the visual satisfaction score (VSS: 100 mm scale, where 100 = fully satisfied and 0 = not satisfied) during the follow-up visit at the postanesthetic clinic. Sensation and muscle strength of the upper extremities were also evaluated.

RESULTS

The mean duration of anesthesia was 159.9±46.4 min, and the mean duration of the operation was 111.5±46.3 min. The success rate was 90.3% (56 out of 62 patients did not require additional analgesia during surgery). After surgery, three patients (4.8%) required pentazocine in addition to diclofenac or flurbiprofen axetil. The average time from BPB to the first administration of postoperative analgesics was 345±248 min. In most successful cases, VAS scores were less than 30 mm at each time point. Muscle strength and skin sensation were completely recovered within about 12 h, and numbness disappeared within about 8 h.

Postoperative analgesics were used within 12 h after surgery in 28 patients (45.2%). The incidences of adverse effects, including the delay of sensation, muscle strength, and numbness (lasting over 12 h), were 4.8%, 3.2%, and 8.1%, respectively. During follow-up, the mean VSS was 87±9 mm.

DISCUSSION

Our results demonstrated that BPB with low-dose ropivacaine under general anesthesia was a clinically acceptable method (success rate, >90%; incidence of adverse events, <10%) with high patient satisfaction (mean VSS around 90). Ropivacaine, a long-acting local anesthetic agent, can cause prolonged numbness and delayed sensory recovery when used for neural blockade. In fact, a small number of patients in this study complained of anxiety owing to numbness and delayed motor and sensory recovery after the surgical procedure. These adverse events likely occurred because of a combination of factors, including nerve blockade by ropivacaine, tourniquet compression, and other surgical procedures.

Taboada *et al*.[8] reported success rates of 89% (using ultrasound) and 91% (using nerve stimulation) for BPB with 40 mL of 1.5% mepivacaine during upper extremity surgery. In contrast to our study, Taboada *et al*. applied BPB for upper extremity surgery without general anesthesia and used a different type of local anesthetic. However, in accordance with our results, it is reasonable to hypothesize that low-dose local anesthetics are probably sufficient for BPB when BPB is performed in combination with general anesthesia.

Yang *et al*.[5] have shown that one shot of 30 mL 0.5% ropivacaine with a continuous infusion of 0.2% ropivacaine at 6 mL/h or 8 mL/h for BPB without general anesthesia provided similar clinical efficacy. On the basis of this result, they concluded that the basal rate should be decreased in light of the toxicity of local anesthetics. Our technique (10 mL of 0.375% ropivacaine) under general anesthesia produced clinical results comparable to their report with respect to the success rate, VAS, adverse effects, and patient satisfaction. Therefore, it is safe to say that the dose of local anesthetics should be considerably decreased when BPB is performed in combination with general anesthesia.

Generally, anesthetic toxicities are increased in proportion to the dose administered.[9-13] Low doses of local anesthetics are favourable in this regard. Based on the present results, it is logical to consider that the conventional dose of ropivacaine should be reduced when used combined with general anesthesia. In addition, the use of the conventional dose of ropivacaine would have increased the occurrence of adverse events, such as prolonged numbness and delayed sensory and motor recovery, even though a higher dose of

ropivacaine or bupivacaine (0.5% at 30 mL) has not been reported to induce any critical events when used for BPB.[5,6]

One of limitations of this study is that we used fixed doses of ropivacaine that were not based upon patient bodyweight. Doses determined by the patient bodyweight may have influenced the results described herein. Additionally, it has been suggested that BPB under general anesthesia can increase the risk of neurologic complications. However, studies have also demonstrated that complications associated with interscalene block regional anesthesia performed after induction of general anesthesia are similar to results describing BPB in nonanaesthetized patients.[14] In our case series, we did not experience complications associated with the performance of BPB under general anesthesia. In addition, almost all of our patients were satisfied with their experience of BPB under general anesthesia. Therefore, we suggest that BPB under general anesthesia was an acceptable method for anesthesia in light of patient safety and efficacy. Lastly, although we used fluoroscopic guidance, we expect that, depending on the situation, ultrasound-guided block can also be used.

We conclude that BPB with low-dose ropivacaine under general anesthesia using the fluoroscopy-guided supraclavicular method is clinically acceptable for upper extremity surgery.

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