J Anesth (2011) 25:927–929
DOI 10.1007/s00540-011-1238-9

CLINICAL REPORT

Ultrasound-guided bilateral brachial plexus blockade with propofol-ketamine sedation

Kazuya Toju · Takahiro Hakozaki · Masahiko Akatsu · Tsuyoshi Isosu · Masahiro Murakawa

Received: 3 March 2011 / Accepted: 12 September 2011 / Published online: 2 October 2011

Abstract We report the use of ultrasound-guided bilateral brachial plexus block in a patient with bilateral radius fractures. An axillary block was performed on the patient's right and a supraclavicular block on her left using an in-plane (long-axis) needle insertion technique. Into each side was injected 20 ml 0.5% ropivacaine, giving a total volume (dose) of 40 ml (200 mg). Provisions were made for rescue analgesia or unplanned conversion to general anesthesia during the operation, but these were not needed; furthermore, no perioperative complications were observed. General anesthesia has traditionally been used for simultaneous surgery involving the bilateral upper extremities because of concerns relating to local anesthetic toxicity, phrenic nerve blockade, and pneumothorax. The ultrasound-guided technique facilitates a reduction in the minimal effective volume of local anesthetic and can prevent potentially critical complications. Moreover, the technique can be performed within the recommended safe dose limits of the anesthetic, rendering it an important option for bilateral upper extremity surgery.

Keywords Ultrasound · Brachial plexus block · Monitored anesthesia care

K. Toju
Department of Anesthesiology, Fukushima Prefectural Minami-Aizu Hospital, Kazashimo 14-1, Tajima, Minami-Aizu, Fukushima, Japan

K. Toju (✉) · T. Hakozaki · M. Akatsu · T. Isosu · M. Murakawa
Department of Anesthesiology, Fukushima Medical University School of Medicine, Hikarigaoka 1, Fukushima, Fukushima 960-1295, Japan
e-mail: m00059kt@jichi.ac.jp

Introduction

Brachial plexus blockade is commonly used for upper extremity surgeries. This regional anesthesia technique provides surgical patients with good intraoperative anesthesia and prolonged postoperative analgesia [1]. However, bilateral brachial plexus blockade is challenging, with concerns relating to local anesthetic toxicity, phrenic nerve blockade, and pneumothorax. Ultrasound enables more effective and safer delivery of regional anesthesia, reducing the volume of local anesthetic required and thus the risk of critical complications [2]. One more concern is the patients have to cope with bilateral paresis during surgery. This point should be explained carefully, and appropriate intraoperative sedation is necessary for patient comfort. Here, we present a case of a patient with bilateral distal radius fractures anesthetized with bilateral ultrasound-guided brachial plexus blockade.

Case report

A 70-year-old woman of body weight 50 kg and height 144 cm was admitted to our hospital because of bilateral radius fractures and was scheduled for simultaneous bilateral surgery. Her medical history revealed transabdominal hysterectomy with spinal anesthesia. She was in good health with well-controlled hypertension and hyperlipidemia. At the preanesthesia visit, she stated that she hoped to avoid general anesthesia. We informed her of the option of ultrasound-guided bilateral brachial plexus blockade with monitored anesthesia care (MAC). As the result of careful discussion between the patient and attending anesthesiologists, we selected bilateral brachial plexus blockade with MAC.

The operating room was managed under the American Society of Anesthesiologists (ASA) standards for basic anesthesia monitoring of electrocardiography, pulse oximetry, noninvasive blood pressure, and capnography. The patient was administered 5 l/min oxygen via a face-mask. After IV access was secured and an atropine 0.5 mg bolus administered, target-controlled infusion (TCI) of propofol was initiated with an estimated plasma level of 2 μg/ml using a Diprifusor (Terufusion Infusion Pump; Terumo, Tokyo, Japan). When there was no verbal response from the patient and a bispectral index (BIS; Aspect Medical Systems, Norwood, MA, USA) level of <75 was obtained, ketamine 40 mg was slowly administered. Propofol was titrated with TCI to maintain BIS within the range 60–75 and to ensure spontaneous ventilation throughout the operation.

Ultrasound-guided brachial plexus blockade was performed via an axillary block on the patient's right and a supraclavicular block on her left. After local infiltration with 1% lidocaine and pre-scanning by ultrasound (MicroMaxx; Sonosite, Bothell, WA, USA) was performed, the blockade was performed using an in-plane (long-axis) technique with a 21-gauge, 50-mm insulated needle (Sonolect needle type CCR; Hakko, Nagano, Japan). The needle was positioned near the plexus under real-time ultrasound guidance; 0.5% ropivacaine was administered with frequent aspirations to avoid intravascular injection, and the needle tip was repositioned to the nerves surrounded by the local anesthetic. We administered 20 ml 0.5% ropivacaine to each side, giving a total administered dose of 40 ml (200 mg).

The right forearm was the first to be operated on. No rescue analgesia was necessary. The estimated plasma level of propofol was maintained at 1.5 μg/ml, and the patient breathed spontaneously without any airway assistance throughout the operation. Propofol was stopped when the left skin suture was started. The patient awoke shortly after the operation and was returned to her ward. The duration of surgery was 170 min, and the total anesthesia time 215 min.

At postoperative interview 24 h after the operation, normal motor and sensory function was present in both arms of the patient. Postoperative chest radiograph and the nursing record were reviewed, and no complications were observed. Postoperative pain was well controlled by oral loxoprofen 60 mg three times per day, and the patient reported no intraoperative awareness or ketamine-associated emergence reactions. She commented that the operation finished during her comfortable sleep and that she felt no pain throughout the day of surgery. She showed great satisfaction with our perioperative care, although the bilateral arm paresis was felt to be somewhat awkward.

Discussion

Peripheral nerve blockade is often performed for surgeries relating to the extremities [1]. Ultrasound-guided blockade was introduced recently and has been shown to lead to safer and more effective anesthesia compared with the classic landmark or nerve stimulator technique [2].

Brachial plexus blockade with the landmark or nerve stimulator technique requires a large volume and dosage of local anesthetic to achieve surgical anesthesia. This requirement prevents bilateral brachial plexus blockade being performed within the recommended safe dose, and anesthesiologists have thus traditionally selected general anesthesia for such cases. Other concerns include phrenic nerve blockade and pneumothorax, which lead to a critical situation if they occur bilaterally. Additionally, bilateral block procedures require a long duration of anesthesia, which can increase patient discomfort [3].

Franco et al. [4] reported subclavicular and axillary bilateral brachial plexus blockade via the nerve stimulator technique without any perioperative complications, and Maurer et al. [5] reported safe performance of interscalene and subclavicular blockade with ropivacaine 350 mg. However, both reports noted that the dosage of local anesthetic required to achieve reliable surgical anesthesia was greater than the recommended safe dose.

Ultrasound-guided nerve blockade reduces the minimal effective volume of local anesthetic, enabling simultaneous blocking of multiple peripheral nerves. It can minimize risks of vascular and pleural punctures because the needle tip is always visualized under real-time ultrasound guidance. Bilateral brachial plexus blockade, thus, has considerable advantages [3].

We chose to use a combined axillary and supraclavicular block for the present patient. The classic axillary approach requires approximately 40 ml local anesthetic. O'Donnell and Iohom [6] reported 2% lidocaine 1 ml is the minimal effective volume per nerve for axillary blockade under ultrasound guidance, and Harper et al. [7] reported 2–3 ml local anesthetic is required for each surrounded nerve under ultrasound imaging ("donut sign"). Axillary blockade is completed by median, ulnar, radial, and musculocutaneous nerve blockade, and 20 ml local anesthetic is sufficient for blockade of all these nerves with ultrasound guidance [6, 7]. The standard supraclavicular approach also requires 30–40 ml local anesthetic, but Soares et al. [8] reported that an appropriate needle position achieved via ultrasound guidance enables a blockade using less than 20 ml local anesthetic. We primarily use a supraclavicular blockade because of its rapid onset and intense effect [8]. However, bilateral supraclavicular blockade is not recommended for reasons of risk of respiratory insufficiency induced by pneumothoraxes or bilateral phrenic nerve

blockade. The risk of pneumothoraxes is minimized with skillful ultrasound-guided technique, but the risk of phrenic nerve blockade is not. Phrenic nerve blockade was reported to occur with interscalene and subclavicular blocks, even in cases where a low volume of local anesthetic was used [9, 10]. For this reason, we should choose the axillary approach for at least one side to prevent bilateral phrenic nerve blockade. Thus, the most suitable block must be chosen on a case-by-case basis when bilateral brachial plexus blockade is planned.

Propofol-ketamine sedation, also known as minimally invasive anesthesia (MIA), was originally developed by Friedberg for cosmetic surgery [11]. This opioid-free technique easily maintains spontaneous ventilation, and ketamine reduces the pain associated with the blocking procedure. Additionally, no drugs associated with postoperative nausea and vomiting or malignant hyperthermia are required. MIA is thus one of the most suitable and safest techniques for MAC, especially in ambulatory surgery. MIA is now used mostly in the field of anesthesia for cosmetic surgery, but it can be also useful for orthopedic anesthesia combined with reliable ultrasound-guided nerve blockade. Of course, anesthesiologists must always be prepared for airway problems or conversion to general anesthesia throughout any operation performed with MAC.

We performed ultrasound-guided bilateral brachial plexus blockade using both an axillary block and a supraclavicular block for a patient with bilateral distal radius fractures. Reliable surgical anesthesia was achieved within the recommended safe dose level for ropivacaine. No perioperative complications were observed. Ultrasound-guided nerve blockade is a suitable option for simultaneous bilateral upper extremity surgery.

References

1. Klein SM, Evans H, Nielsen K, Tucker M, Warner D, Steele S. Peripheral nerve block technique for ambulatory surgery. Anesth Analg. 2005;101:1663–76.
2. Marhofer P, Greher M, Kapral S. Ultrasound guidance in regional anaesthesia. Br J Anaesth. 2005;94:7–17.
3. Holborow J, Hocking G. Regional anaesthesia for bilateral upper limb surgery: a review of challenges and solutions. Anaesth Intensive Care. 2010;38:250–8.
4. Franco CD, Salahuddin Z, Rafizad A. Bilateral brachial plexus block. Anesth Analg. 2004;98:518–20.
5. Maurer K, Ekatodramis G, Rentsch K, Borgeat A. Interscalene and infraclavicular block for bilateral radius fracture. Anesth Analg. 2002;94:450–2.
6. O'Donnell BD, Iohom G. An estimation of the minimum effective anesthetic volume of 2% lidocaine in ultrasound-guided axillary brachial plexus block. Anesthesiology. 2009;111:25–9.
7. Harper GK, Stafford MA, Hill DA. Minimum volume of local anaesthetic required to surround each of the constituent nerves of the axillary brachial plexus, using ultrasound guidance: a pilot study. Br J Anaesth. 2010;104:633–6.
8. Soares LG, Brull R, Lai J, Chan VW. Eight ball, corner pocket: the optimal needle position for ultrasound-guided supraclavicular block. Reg Anesth Pain Med. 2007;32:94–5.
9. Perlas A, Lobo G, Lo N, Brull R, Chan VW, Karkhanis R. Ultrasound-guided supraclavicular block. Reg Anesth Pain Med. 2009;34:171–6.
10. Rettig HC, Gielen MJ, Boersma E, Klein J, Groen GJ. Vertical infraclavicular block of the brachial plexus: effects on hemidiaphragmatic movement and ventilatory function. Reg Anesth Pain Med. 2005;30:529–35.
11. Friedberg BL. Propofol ketamine with bispectral index (BIS) monitoring. In: Anesthesia in cosmetic surgery. 1st edn. New York: Cambridge University Press; 2007. p. 1–13.