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CASE REPORT

Multimodal Analgesia for Shoulder Rotator Cuff Surgery Pain: The Role of Naldebain® and Ultrasound-Guided Peripheral Nerve Blocks Combination

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Multimodal analgesia (MMA) strategy is widely used for anesthesia and perioperative pain management. MMA provides continuous and satisfactory postoperative pain management, subsequently prevents patients from the development of chronic postsurgical pain (CPSP). We report a 55-year-old female patient with impingement syndrome and provide an MMA protocol for rotator cuff surgery with satisfactory pain management, which combines oral nonopioid analgesics, long-acting dinalbuphine sebacate (Naldebain ER Injection) and ultrasound-guided peripheral nerve blocks. This protocol modifies the timing of long-acting dinalbuphine sebacate injection, thus decreases dinalbuphine sebacate associated side effects. The ultrasound-guided nerve block provides enough time for long-acting dinalbuphine sebacate to reach the therapeutic level. Moreover, multiple oral analgesics act as preventive analgesia, which further enhances postoperative long-acting dinalbuphine sebacate analgesia. We suggest that this MMA protocol can be performed successfully in patients receiving shoulder surgery to provide good pain management and inhibits the consequent CPSP. We believe this MMA protocol may also be used in other types of surgery.

Key words: Chronic postsurgical pain, multimodal analgesia, naldebain, preventive analgesia, ultrasound-guided peripheral nerve blocks

INTRODUCTION

Multimodal analgesia (MMA) involves the use of two or more analgesics or modalities with different mechanisms to achieve clinically required analgesia. Uncontrolled postsurgical pain has been associated with increased risk of poor wound healing, impaired immune function and prolonged hospital stay and subsequently develop chronic post-surgical pain (CPSP). The American Society of Anesthesiologists (ASA) and the American Pain Society (APS) recommend use of multimodal approach for postoperative pain control. It can significantly minimize side effects associated with high dose of a single medication, such as opioid analgesic. This article presents a case based on an MMA strategy for postoperative pain management with satisfactory pain relief and no obvious related side effects.

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Ethical approval

The institutional review board of the Cathay General Hospital (CGH), Taipei, Taiwan, Republic of China approved the study design on August 26th, 2019 (CGH-IRB No.: CGH-P108075) and the informed consent form was obtained from the patient.

CASE REPORT

A 55-year-old female patient who was diagnosed impingement syndrome with rotator cuff tears of her right shoulder. She had a history of hypertension and hyperlipidemia, which were under well medical control. Before the operation, there was no clinical significant finding through routine laboratory examination, electrocardiogram, and chest X-ray.

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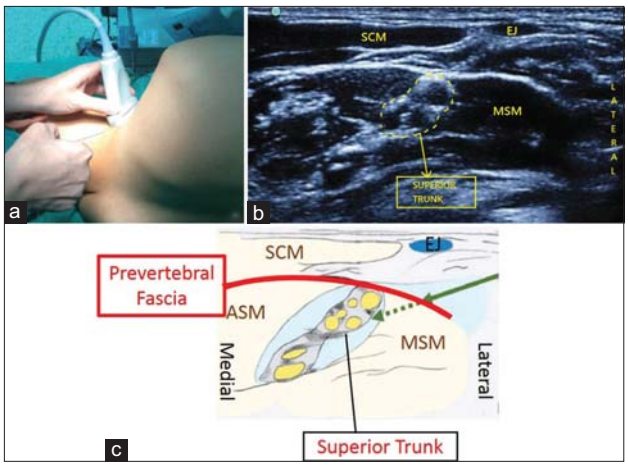

Figure 1: The single-penetration double-injection approach to peripheral nerve block for the patient (a and b). The patient was placed in the lateral decubitus position with the right side up (a). Preinjection sonogram is showed as (b). With the long axis of the transducer oriented along the visual axis, the needle is inserted in-plane lateral to sternocleidomastoid toward the superior trunk. A sketch is made corresponding to the post-injection sonogram (c). The needle is shown by the green arrow in the sketch. Single-penetration double-injection approach includes one injection posterior to the superior trunk and the other over middle scalene muscle. After spreading around the superior trunk (from the dotted green needle tip), the needle is then pulled back to place its tip (the solid green arrow) over the prevertebral fascia above middle scalene muscle. Blue shaded area indicates the spread of injectate from the green needle tip. EJ: External jugular vein, MSM: Middle scalene muscle, SCM: Sternocleidomastoid muscle, ASM: Anterior scalene muscle

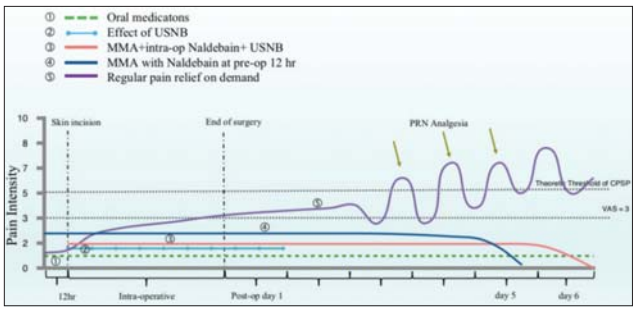

Figure 2: Multimodal analgesia protocol of the patient for the perioperative pain management and possible mechanism of chronic postsurgical pain prevention.The apple green dotted line represents oral medication of gabapentin 100 mg (tid), dextromethorphan 60 mg (bid), and Celebrex 200 mg (bid), which were given at 12 h and 2 h before the operation and another 5 days after surgery (1). The cyan blue line represents ultrasound-guided nerve block after general anesthesia induction for intra-operative and postoperative day 1 nociception block (2). The orange-red line represents Naldebain injection immediately after general anesthesia induction, which continuously effects during the whole operation; it provides another 6 days pain control after surgery (3). The navy blue line represents standard Naldebain injection at 12–24 h before the operation to reach the pharmacology plateau (4). The purple line represents regular postoperative analgesia in patients with regular general anesthesia practice (lack of MMA for intraoperative pain inhibition), and the postoperative analgesia was administered per patients' request, the pain medications may not be given immediately after patients' request, which the nociceptive stimuli may break a threshold to develop CPSP (5). In our patient, MMA 1 + 2 + 3 were given for the perioperative MMA management, and the patient was discharged on day 3 after the surgery. This MMA protocol provided a satisfactory relief with complete coverage of perioperative noxious stimuli and, thus, the prevention of CPSP.

In preoperative anesthesia assessment, the American Society of Anesthesiologists (ASA) was graded to Class II. Oral preventive analgesics, including celecoxib (200 mg), dextromethorphan (60 mg), and gabapentin (100 mg) were given at 12 h and 2 h before the operation, respectively. On the patient placed in the operating room, all vital signs were monitoring and showed as stable. General anesthesia was conduct with induction by glycopyrrolate 0.2 mg, 2% lidocaine 50 mg, propofol 140 mg, fentanyl 200 mcg, rocuronium 50 mg, and dexamethasone 5 mg. After adequate anesthesia established, the patient was intubated with a 7.0 mm cuffed endotracheal tube and maintained anesthesia by desflurane. The patient was placed in the right side up of lateral decubitus position and intramuscularly administrated a single dose of long-acting dinalbuphine sebacate (Naldebain® ER Injection, Lumosa Therapeutics Co. Ltd., Taiwan) at the right gluteus maximus. Then, the ultrasound-guided nerve block was performed with hydrodissection by pressure monitoring technique [Figure 1].[1] A single-penetration double injection technique, combined with superior trunk block and supraclavicular nerve block was used for perioperative analgesia (0.5% ropivacaine with 1:400,000 epinephrine, total 20 mL). To complete the supraclavicular nerve block at the superior trunk level, superficial. To complete supraclavicular nerve block at the superior trunk level, superficial cervical plexus block at the cervical neural pathway was also performed (1.5% lidocaine with 1:400,000 epinephrine, total amount of 8 mL). The patient kept hemodynamically stable throughout the operation. After sugammadex 200 mg given, extubation was performed smoothly at the operating room, and then transferred the patient to the postoperative anesthesia recovery room (POR). The patient denied pain (visual analog scale [VAS] score <3 during POR stay) or postoperative nausea or vomiting, but right-sided scalp numbness, mild difficulty of respiration and right-sided. Horner syndrome was found at POR. Under the use of nasal cannula with 3 L/min oxygen, oxygen saturation was maintained between 95% and 100% level. When these discomforts were tolerable and became stable conditions, the patient was transferred to the general ward for further postoperative care. At 8 h after surgery, the patient spontaneously reported that symptoms of Horner syndrome and scalp numbness were recovery. At 12 h after the surgery, there was no symptom of diaphragm paralysis. On the second day after surgery, the patient could freely move her right arm. Celecoxib (200 mg, q12 h), gabapentin (100 mg, tid), and dextromethorphan (60 mg, q12 h) were prescribed during the postoperative recovery period [Figure 2]. The

postoperative pain was well-controlled (VAS score <3) during the hospital stay, and the patient was discharged 3 days after the surgery. From discharge to first follow-up visit (6 days after surgery), adequate pain control (VAS score <3) was reported and satisfied. This case report was reviewed and approved by Cathay General Hospital IRB (CGH-IRB No.: CGH-P108075), and written consent was obtained from the patient.

DISCUSSIONS

Chronic postsurgical pain (CPSP) is defined as persistent pain longer than 2 months after surgery, excluding other causes of pain such as malignancy, infection, and preexisting pain problem.[2] CPSP may occur after many procedures if the postoperative pain is not managed properly. Unrelieved CPSP is highly associated with adverse physiological changes that increase morbidity and mortality. To improve CPSP management, multimodal analgesia (MMA) has been proposed for perioperative pain control.[3]

MMA is defined as the use of two or more analgesics or delivery routes to improve perioperative analgesia and a continuation from preoperation to a significant period after surgery that is called preventive analgesia. MMA improves postoperative pain control, subsequently improves patients' satisfaction and quality of recovery; it is the main part of we anesthesiologists for enhanced recovery after surgery practice. The ASA and the American Pain Society recommend the use of the multimodal approach for postoperative pain control; the regimen includes a combination of opioids, acetaminophen, nonselective nonsteroidal anti-inflammatory drugs, selective cyclooxygenase-2 inhibitor, α-2 agonists (clonidine and dexmedetomidine), anticonvulsants (gabapentin and pregabalin), and local anesthetics during the perioperative period via various routes.[4] In our case, a combination of oral analgesics, including celecoxib, gabapentin, and dextromethorphan, were used during the whole perioperative period for preventive pain management. Furthermore, intramuscular long-acting dinalbuphine sebacate was given immediately after general anesthesia induction; it was newly introduced in Taiwan recently as a slow-release nalbuphine prodrug with long duration of action; it delivers and maintains an effective blood level for approximately 6 days. However, long-acting dinalbuphine sebacate is recommended intramuscular injection at 24 h before surgery for attaining peak plasma concentration. This regimen provides preemptive analgesia and continuous postoperative pain control for at least 5 days. It shows potential as an ideal analgesic when used in combination with other postoperative pain management for the prevention of CPSP development.[3] However, patients usually complain of pain and afraid of a long needle when injects deeply into the muscle layer of the gluteal region. Moreover, long-acting dinalbuphine sebacate related side effects, like nausea and dizziness, are peaked at 12 h after injection before the operation. To resolve this problem, we injected long-acting dinalbuphine sebacate just after general anesthesia induction and before the operation in this case. Due to the drug pharmacokinetic consideration, we combined the injection with immediate ultrasound peripheral nerve block, which offers as long as 12–24 h for postoperative analgesia; it provides enough time for long-acting dinalbuphine sebacate to reach the therapeutic level after patient emergent from general anesthesia [Figure 2]. This MMA protocol can resolve the problem of injection pain and needle phobia with satisfactory perioperative pain relief in our present patient. Celecoxib, dextromethorphan, and gabapentin had all been demonstrated to have an opoid-sparing effect and were used in MMA regimens. Celecoxib also has hypoalgesic effect of hyperalgesia mediated by the peripheral κ-opioid receptor, which long-acting dinalbuphine sebacate acts on. Gabapentin, by causing preoperative anxiolysis, may have a positive effect on postoperative pain relief and thereby reduced opioid requirement. In addition, Eckhardt *et al*. had shown a synergistic effect of opioid and gabapentin in healthy human volunteers.[5] These three oral drugs (gabapentin, celecoxib, dextromethorphan) used in this case not only provided analgesic effect by themselves but also enhanced the analgesia of long-acting dinalbuphine sebacate. Further study should be designed for the interactions between long-acting dinalbuphine sebacate and other oral analgesics.

Perioperative regional analgesia with ultrasound-guided peripheral nerve blocks has been reported to improve patients' satisfaction in postoperative pain management and facilitate early rehabilitation.[6,7] Therefore, perineural analgesia is currently a favored technique for limb surgery and postoperative pain management as part of the MMA regimen. An intense peripheral nerve block may completely prevent noxious stimuli reach the central nervous system to avoid central sensitization and thus inhibits the risk of CPSP. For shoulder surgery, interscalene brachial plexus block (ISB) is commonly administered in conjunction with general anesthesia for postoperative analgesia.[8-11] The previous study has shown that ISB with long-acting local anesthetic in outpatients undergoing rotator cuff surgery can provide efficient and reliable surgical conditions, such as faster same-day recovery, fewer adverse events, better analgesia immediately after surgery, and greater patient acceptance.[12] In a recent study, Lin *et al*. suggested that, for shoulder surgery, the C3 and C4 cutaneous branches should also be covered in addition to conventional interscalene block.[13] Thus, in this case we blocked

the terminal nerve from C3 and C4 innervating the shoulder region, namely the supraclavicular nerve, specifically.[14] Under this technique, Horner syndrome, diaphragm paralysis, and facial numbness may occur. Ipsilateral phrenic nerve block resulting in diaphragmatic paresis occurs in 100% of patients undergoing ISB, even with dilute solutions of local anesthetics, and is associated with a 25% reduction in pulmonary function. Fortunately, this side effect is well tolerated in patients with normal respiratory function. Horner syndrome (ptosis, miosis, and anhydrosis) is caused by the sympathetic blockade of the ipsilateral face and arm, is thought excellent for pain control. These effects are usually observed and lasted in the duration of the blockade. The sympathetic nervous system has a role in vascular, visceral, and neuropathic pain. A blockade of sympathetic ganglia can offer pain relief for sympathetically mediated pain. Historically, immediate and transient relief from pain and dysesthesia after sympathetic nerve block (stellate ganglion block or lumbar sympathetic block) was considered to be supportive of a diagnosis of complex regional pain syndrome. The blockade of the sympathetic chain seems to enhance acute pain control and also in preventing the development of persistent postoperative pain.[15] A successful superficial cervical block will cause numbness over the head and neck area; it however, means that supraclavicular nerve is well blocked; thus, the patient will be free of pain even in a mini-open shoulder arthroscopy surgery.

In conclusion, MMA strategies are widely used for anesthesia practice, particularly in the EARS protocol. In our case, the MMA protocol for prevention of CPSP included perioperative rapid onset opiates, nonopioid analgesics, long-acting dinalbuphine sebacate, and ultrasound-guided peripheral nerve blockade. Long-acting dinalbuphine sebacate was given after general anesthesia induction, instead of preoperative 12–24 h, to improve the patient's satisfaction by eliminating needle phobia and reducing dinalbuphine sebacate-related side effects. Besides, we performed superior trunk block in combination with superficial cervical plexus block to offer 12–24 h for postoperative analgesia, which also provided enough time for long-acting dinalbuphine sebacate to reach the therapeutic level. Moreover, a fully cover the perioperative preventive analgesia by a multiple analgesics, celecoxib, dextromethorphan, and gabapentin oral ingestion may further enhancing long-acting dinalbuphine sebacate analgesia. All the discomforts caused by nerve blockade were reported tolerable by the patient; however, these side effects, such as Horner syndrome and facial numbness, may be manifestations of a successful blockade. We suggest that this MMA model, the combination of perioperative oral analgesics plus long-acting dinalbuphine sebacate and ultrasound-guided peripheral nerve blocks, may also be performed successfully in other patients receiving shoulder surgery. We suppose that it provides a good perioperative pain management and inhibits the consequent CPSP. However, more cases should be studied for this combination of the pain management protocol. Further, a randomized controlled trial should be designed to determine the precise use of long-acting dinalbuphine sebacate for perioperative pain management.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. The patient has given her consent for her images and other clinical information to be reported in the journal. The patient understand that her name and initials will not be published and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Lin JA, Lin KH, Hsu AC, Tai YT. Modified half-the-air technique for continuous pressure monitoring during lumbar plexus block. Eur J Anaesthesiol 2018;35:803-5.
2. Macrae WA. Chronic post-surgical pain: 10 years on. Br J Anaesth 2008;101:77-86.
3. Huang CC, Sun WZ, Wong CS. Prevention of chronic postsurgical pain: The effect of preventive and multimodal analgesia. Asian J Anesthesiol 2018;56:74-82.
4. Chou R, Gordon DB, de Leon-Casasola OA, Rosenberg JM, Bickler S, Brennan T, *et al*. Management of postoperative pain: A Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. J Pain 2016;17:131-57.
5. Eckhardt K, Ammon S, Hofmann U, Riebe A, Gugeler N, Mikus G. Gabapentin enhances the analgesic effect of morphine in healthy volunteers. Anesth Analg 2000;91:185-91.
6. Green C, Byrne AM, O'Loughlin P, Molony D, Harmon D, Masterson E. Surgeon delivered psoas compartment block in total hip arthroplasty. J Arthroplasty 2014;29:393-6.
7. Heesen M, Klimek M, Imberger G, Hoeks SE, Rossaint R,

Straube S. Co-administration of dexamethasone with peripheral nerve block: Intravenous vs. perineural application: Systematic review, meta-analysis, meta-regression and trial-sequential analysis. Br J Anaesth 2018;120:212-27.
8. Borgeat A, Dullenkopf A, Ekatodramis G, Nagy L. Evaluation of the lateral modified approach for continuous interscalene block after shoulder surgery. Anesthesiology 2003;99:436-42.
9. Iskandar H, Benard A, Ruel-Raymond J, Cochard G, Manaud B. The analgesic effect of interscalene block using clonidine as an analgesic for shoulder arthroscopy. Anesth Analg 2003;96:260-2, table of contents.
10. Neal JM, McDonald SB, Larkin KL, Polissar NL. Suprascapular nerve block prolongs analgesia after nonarthroscopic shoulder surgery but does not improve outcome. Anesth Analg 2003;96:982-6.
11. Borgeat A, Tewes E, Biasca N, Gerber C. Patient-controlled interscalene analgesia with ropivacaine after major shoulder surgery: PCIA vs. PCA. Br J Anaesth 1998;81:603-5.
12. Hadzic A, Williams BA, Karaca PE, Hobeika P, Unis G, Dermksian J, *et al*. For outpatient rotator cuff surgery, nerve block anesthesia provides superior same-day recovery over general anesthesia. Anesthesiology 2005;102:1001-7.
13. Lin JA, Chuang TY, Yao HY, Yang SF, Tai YT. Ultrasound standard of peripheral nerve block for shoulder arthroscopy: A single-penetration double-injection approach targeting the superior trunk and supraclavicular nerve in the lateral decubitus position. Br J Anaesth 2015;115:932-4.
14. Maybin J, Townsley P, Bedforth N, Allan A. Ultrasound guided supraclavicular nerve blockade: First technical description and the relevance for shoulder surgery under regional anaesthesia. Anaesthesia 2011;66:1053-5.
15. Costache I, Pawa A, Abdallah FW. Paravertebral by proxy – Time to redefine the paravertebral block. Anaesthesia 2018;73:1185-8.