Perioperative Analgesia Using an Indwelling Catheter to Deliver an Inferior Alveolar Nerve Block: A Case Report

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A 74-year-old male was diagnosed with osteomyelitis of the left mandible requiring marginal mandibulectomy under general anesthesia. However, the patient's pulmonary function tests demonstrated findings consistent with severe chronic obstructive pulmonary disease, classified as stage III. The consulting pulmonologist explained the increased risk of respiratory complications associated with general anesthesia and advised against its use. Therefore, we opted to perform the surgery under moderate sedation using 0.2% ropivacaine administered via bilateral ultrasound-guided inferior alveolar nerve blocks (UGIANBs) and an indwelling catheter with a pump for continuous perioperative local anesthesia and prolonged postoperative analgesia. This approach delivered excellent local anesthetic effects without any need for rescue medications or complications. Use of UGIANBs along with an indwelling catheter and pump may provide adequate local anesthesia and postoperative analgesia in patients with contraindications for general anesthesia.

Key Words: Nerve block; Inferior alveolar nerve block; Analgesia; Catheter technique; Surgery; Moderate sedation; Ultrasound guidance; Ropivacaine.

General anesthesia is associated with a high risk of serious complications among elderly patients with severe respiratory and/or cardiovascular comorbidities, which can make planning for safe general anesthesia difficult. When surgical interventions do not necessitate general anesthesia, alternative anesthetic approaches with more optimal prognoses should be considered. In addition, high-risk patients often experience difficulty with adequate postoperative analgesia due to the avoidance of traditional analgesics that are more likely to cause complications.[1] For example, nonsteroidal anti-inflammatory drugs carry a substantial complication risk for patients with gastrointestinal or renal impairment.[2] Opioids are also commonly used for perioperative analgesia after oral and maxillofacial surgery; however, their use in elderly patients can increase the risk of delirium and postoperative nausea and vomiting.[3]

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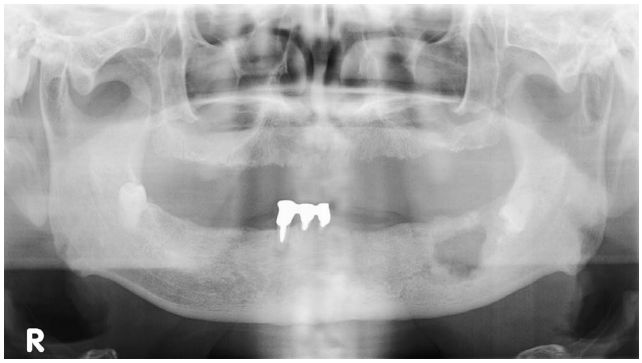
Peripheral nerve blocks using an indwelling catheter and infusion pump system for continuous local anesthetic delivery have been demonstrated to be effective in various surgeries including those involving the head and neck region.[4–6] Kumita et al[7] reported that ultrasound-guided maxillary nerve blocks (UGMNBs) and ultrasound-guided inferior alveolar nerve blocks (UGIANBs) were effective perioperative analgesic procedures for orthognathic surgery. UGMNBs and UGIANBs are categorized as compartmental blocks and can be utilized for surgeries involving anatomic sites innervated by the second and third branches of the trigeminal nerve (V2/V3).

In this case report, we describe a novel technique of administering an UGIANB with a catheter for perioperative analgesia. This technique involves connecting a patient-controlled analgesia (PCA) pump to the end of an indwelling catheter placed near the target nerve under ultrasound guidance, allowing for continuous administration of local anesthetic. We propose that the novel technique described herein would be effective for acute intraoperative anesthesia and extended postoperative analgesia for head and neck surgery.

Written informed consent was obtained from the patient for the publication of this case report and

Figure 1. Preoperative Panoramic Radiograph.



Panoramic radiograph illustrating osteomyelitis of the left mandible.

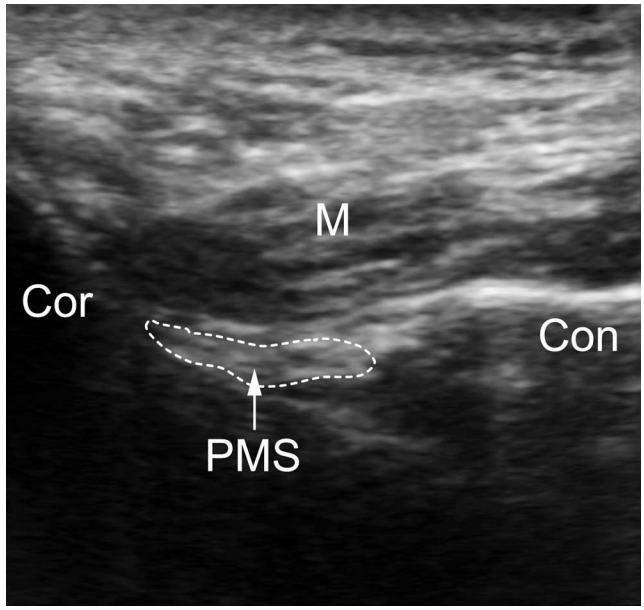
accompanying images. This study was approved by the ethics review board of our medical center (approval number: 2022031534) and was conducted in accordance with the principles of the Declaration of Helsinki and its later amendments.

CASE PRESENTATION

A 74-year-old male (height, 163 cm; weight, 68 kg; body mass index, 25 kg/m^2) presented with sharp pain in the left lower mandible. The patient had a history of chronic obstructive pulmonary disease (COPD), hyperlipidemia, and allergy to alcohol, and his medications included pitavastatin and a budesonide/glycopyrrolate/formoterol inhaler (1 time/d). He was also a smoker, having smoked 20 cigarettes per day for 55 years.

Upon examination, the patient was diagnosed with osteomyelitis of the left mandible (Figure 1). The osteomyelitis had spread close to the midline; thus, the patient was initially scheduled for left marginal mandibulectomy without plating under general anesthesia. Routine preoperative electrocardiography yielded no remarkable results, and routine blood tests revealed hemoglobin levels of 10.1 g/dL. Routine pulmonary function tests revealed a forced expiratory volume in 1 second (FEV_1) of 1.70 L and percent predicted FEV_1 of 43.1%, indicating severe COPD classified as Stage III. A pulmonology consult was then obtained. The pulmonologist clarified the increased risk of respiratory complications associated with general anesthesia for this patient and advised that general anesthesia be avoided if possible. Given that the surgery could be performed without general anesthesia, the patient opted to proceed with the surgery under intravenous (IV) moderate sedation rather than general anesthesia due to the increased risk.

Figure 2. Ultrasound Imaging Before Needle Insertion.



Ultrasound image illustrating the pterygomandibular space. Cor, coronoid; Con, condyle; M, masseter; PMS, pterygomandibular space.

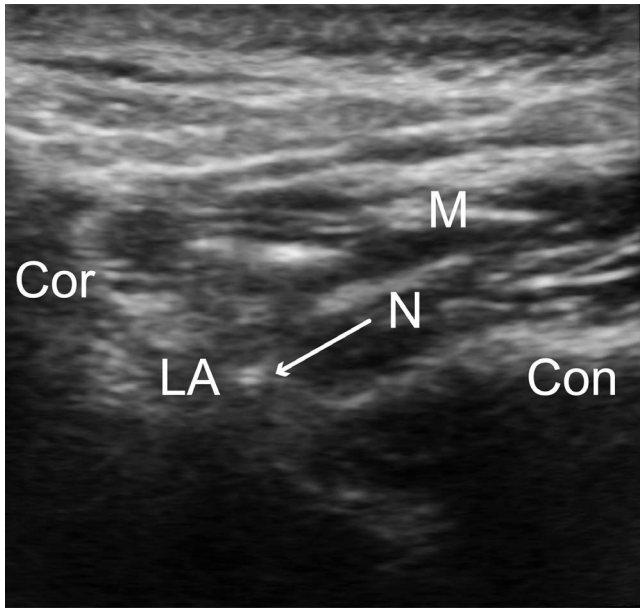
On the day of surgery, the patient arrived having appropriately fasted. Standard anesthetic monitors consisting of an electrocardiogram, a sphygmomanometer, and a pulse oximeter were applied in the operating room after he was placed in the supine position on the operating table. Supplemental oxygen (1 L/min) was administered to the patient via nasal cannula. Capnograph was not used during the surgery. Once the patient was moderately sedated with midazolam and propofol, the puncture site for the percutaneous UGIANB was appropriately disinfected, a sterility drape was applied, and the subsequent procedure was performed under fully sterile conditions.

An ultrasound transducer or probe (SonoSite S II, Fujifilm) was used to visualize the masseter and lateral pterygoid muscles bilaterally as UGIANBs were planned for both sides. The space between these muscles is termed the pterygomandibular space (PMS)[7] and contains the inferior alveolar nerve (Figure 2). The percutaneous insertion sites were anesthetized first using 2 mL of 1% lidocaine (20 mg) per side. An 18-G, 80-mm needle (Perican, B. Braun) was inserted to approximately 30 mm to reach the PMS via the percutaneous, extraoral approach (Figure 3). Bilateral UGIANBs were administered with 5 mL of 0.2% ropivacaine on each side (10 mg/side; 20 mg total). Since this technique is a compartmental block, it was possible to visually confirm the position of the needle entering the PMS and the spread of local anesthetics under ultrasound guidance

Figure 3. Positioning of Ultrasound Probe and Needle.

Ultrasound probe and needle used to perform percutaneous nerve block positioned on a skull model.

Figure 4. Ultrasound Imaging During Injection.

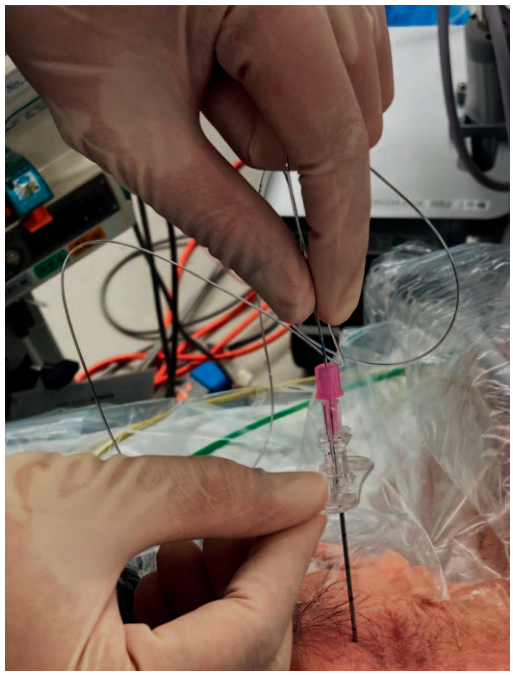


Ultrasound image illustrating the needle and spread of local anesthetic solution. Cor, coronoid; Con, condyle; M, masseter; N, needle; LA, local anesthesia.

(Figure 4).[7,8] After confirming the patient's vital signs were normal, a flexible indwelling catheter (Perifix, B. Braun) was advanced through the needle lumen (Figure 5). The needle was then removed, and the catheter was secured in place with tape (Figure 6). Since the main surgical site was on the patient's left side, the catheter was placed only on the left. The operation time was 1 hour 28 minutes and anesthesia time was 2 hours 20 minutes. The time needed to perform the bilateral UGIANBs was 35 minutes.

The patient remained moderately sedated during the surgery using midazolam (total 7.5 mg) and propofol (total 50 mg). No significant changes in blood pressure and heart rate were observed during administration of the UGIANBs or throughout the surgical procedure. Normal vital signs are commonly defined as fluctuations ± 20% of baseline or normal range; in this case, variations in heart rate and blood pressure were within 10%. The patient's pulse oximeter remained stable (97%–100%) with the supplemental oxygen (1 L/min) via nasal cannula. There were no overt complaints of numbness or pain during catheter placement, and the UGIANBs were considered sufficient as the patient did

Figure 5. Catheter Insertion Through the Needle.



Needle is held in place as the flexible indwelling catheter is advanced.

not complain of pain during the operation. Of note, the patient's jaw was not wired closed.

A PCA pump (Rakuraku Fusor, Aubex) with 0.2% ropivacaine was connected to the indwelling catheter 30 minutes before the end of surgery. The lockout time was set at 30 minutes, and the injected volume of local anesthetic was set at 3 mL (6 mg) per button activation, administered at a rate of 4 mL/h. The intraoperative local anesthetic totals were 4 mL of 1% xylocaine (40 mg) and 10 mL of 0.2% ropivacaine (20 mg). The total volume of 0.2% ropivacaine administered per the PCA over 48 hours was 192 mL (384 mg). No rescue local anesthetics or analgesics were administered perioperatively, and no obvious complications or perceptual or motor deficits were observed. No complications were observed during the administration of local anesthetics using the PCA. The patient was discharged from the hospital on postoperative day 5.

DISCUSSION

We described a novel technique of administering perioperative and prolonged postoperative local anesthesia with UGIANBs and the use of an indwelling catheter and PCA pump. The catheter was placed safely and accurately under ultrasound imaging. This technique not only provides intraoperative local anesthesia but also sustained postoperative pain relief via catheterization, which permits additional local anesthetic delivery. Kojima et al[9] reported that UGIANB with ropivacaine prolongs local anesthetic effects postoperatively and reduces the number of analgesics required postoperatively compared with conventional analgesic methods such as opioids and acetaminophen. An UGIANB with ropivacaine is an effective method for delivering profound and prolonged local anesthesia for patients with severe medical comorbidities. Although UGIANBs are generally performed under general anesthesia, they can also be administered under sedation.[10]

The PMS generally represents a potential space approximating 2 mL.[11] Kumita et al[12] reported that 5 mL of dye sufficiently stained the inferior alveolar nerve, lingual nerve, and buccal nerve to enable identification upon dissection in a cadaver study of UGIANBs. Accordingly, our technique in the present case involved continuous local anesthetic administration at a flow rate of 4 mL/h (lockout time set at 30 minutes, injected volume 3 mL/button activation). Our patient progressed comfortably without the use of rescue medications or flushing of the PCA pump, indicating that this flow rate provided adequate analgesia. However, the size of the PMS may vary with body size, and more detailed studies are needed to determine the appropriate flow rate.

Further, it is common to use 0.2% to 0.375% ropivacaine when administering this type of nerve block.[7] Use of a higher concentration local anesthetic increases the risk of local anesthetic toxicity occurring. Compared with other local anesthetics, ropivacaine has the additional advantage of inducing vasoconstriction at low concentrations (ie, 0.2%–0.375%), thereby reducing the risk of toxicity.[13] High ropivacaine concentrations can cause sympathetic nerve blockade, resulting in hypotension and bradycardia. Accordingly, 0.2% ropivacaine was used as the local anesthetic in the present case. The volume limit of ropivacaine administered is 3 mg/kg. Considering his body weight and the duration of the continuous infusion (2 days), the local anesthetic dosages used were sufficient to ensure safety.

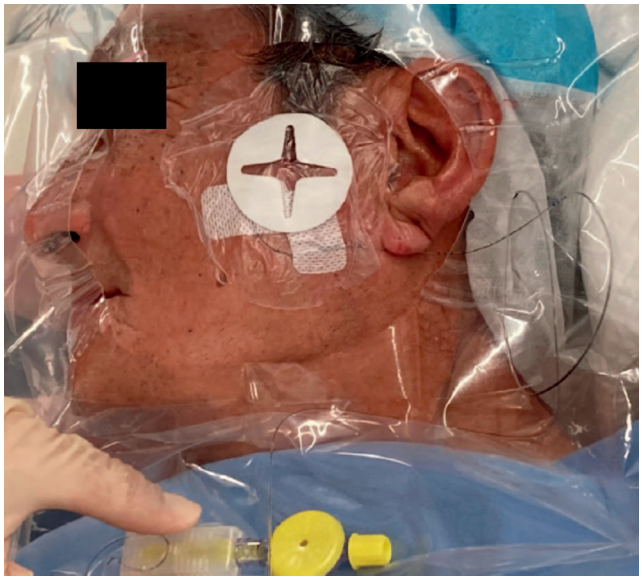
A trigeminal nerve block can be performed using not only ultrasound guidance but also fluoroscopic guidance, electrical nerve stimulation, and landmark/anatomic guidance.[5,14] There is no evidence regarding the success rate of this procedure or the rate of complications of UGIANBs. However, there is evidence that ultrasound-guided peripheral nerve catheters show a higher success rate and lower risk of accidental vascular puncture than of those placed using electrical nerve stimulation.[15] Owing to the many complex blood vessels in the maxillofacial region, this technique should be performed under ultrasound guidance.

Catheter placement in the trigeminal nerve region has been extensively reported. Stringer and Borumandi[16] and Hammond et al[4] described intraoral catheter placement for continuous local anesthesia delivery in patients with trigeminal neuralgia. However, considering the increased bacterial load, an intraoral indwelling catheter is likely to be associated with a greater susceptibility to infection than a catheter placed extraorally.

A fluoroscopy-based extraoral approach has also been reported,[5] but it has the added disadvantage of radiation exposure. Catheter placement based on anatomical landmarks has also been described.[6,17] However, there remains a risk of injuring anatomical structures that cannot be visualized, such as blood vessels. Catheter placement under ultrasound guidance by doctors and dentists could help avoid such complications.[18] To the best of our knowledge, this is the first report of UGIANBs combined with an indwelling catheter and PCA pump for delivering local anesthesia perioperatively. Appropriate indwelling catheter time will need to be determined based on future cases.

This method has 2 notable limitations. First, placement of the catheter in the facial region can induce psychological discomfort in the patient. Second, shaving

Figure 6. Catheter Placement.



Photograph illustrates the flexible indwelling catheter taped securely into place.

of the facial hair is necessary to securely tape the catheter in place and avoid contamination. Catheter infections increase the risk of cellulitis/abscess formation during local anesthetic delivery into the PMS, and such an infection in the head and neck region can be extremely dangerous. Therefore, sterile technique and handling of indwelling catheters is critical. Despite these limitations, this technique is a novel approach for improved perioperative and prolonged pain control during head and neck surgery. Its use may allow safer and more comfortable administration of local anesthesia to patients who have traditionally had difficulties with general anesthesia. However, usefulness of this technique should be further assessed through rigorous investigations and case series with statistical analyses.

CONCLUSION

We describe the use of UGIANBs along with an indwelling catheter and PCA pump for delivering effective perioperative local anesthesia and prolonged postoperative analgesia. Using this method, 0.2% ropivacaine can be administered continuously through an indwelling catheter connected to a PCA pump. Although our findings need to be confirmed with highly powered future investigations, we believe that this technique can effectively facilitate prolonged postoperative analgesia in oral and maxillofacial surgery, and our findings could guide future research directions, medical guidelines, and effective clinical decision-making.

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