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The effectiveness and safety of a novel ultrasound-guided clavipectoral plane block for midshaft clavicle surgeries – a case series

Aileen Rosales

Lot 24 Aguinaldo Street Pacita Complex I San Pedro City, Laguna 4023, Philippines.

***Corresponding Author**: Onyeocha Veronica Ogechi, Department of Chemistry, Federal University of Technology, Owerri, 1526, Nigeria.

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Abstract

Clavipectoral plane block (CPB), a novel block first described in the 2017 European Society of Regional Anaesthesia Congress. This study was a retrospective, descriptive, observational case series of seven patients with midshaft clavicle fractures. Two were given CPB; one under sedation and one under general anesthesia. Both had pain after Post-Anesthesia Care Unit (PACU) discharge up to 24 hours after surgery, but none required opioid medications post-operative. Among the five patients who had CPB with Superficial Cervical Plexus (SCP) block, four were under sedation and one under general anesthesia. All five patients had pain after PACU discharge up to 24 hours after surgery, and one patient previously under sedation had required opioid medication after PACU discharge. CPB with or without SCP block provided effective and safe anesthesia and analgesia to patients who underwent clavicle surgery under general anesthesia or intravenous sedation.

Keywords: *Analgesia; Anesthesia; Clavicle; Local anesthesia; Nerve block; Pain, postoperative; Ultrasound-guided.*

Introduction

The clavipectoral fascial plane block was first described in the 2017 European Society of Regional Anaesthesia Congress as a simple and safe technique that can provide anesthesia and prolonged analgesia for clavicle fractures [1]. Several case reports and case series were already published supporting the effectiveness of this novel block. However, data demonstrating the effectiveness of clavipectoral plane block (CPB) in clavicle surgeries are still limited. Currently, a case series by Atalay et al [2] provided the greatest number of patients wherein CPB was done post-operatively to five American Society of Anesthesiologists (ASA) physical status male patients for clavicle surgery.

This case series primarily aims to demonstrate the effectiveness and safety of using clavipectoral plane block with or without superficial cervical plexus block as surgical anesthesia in patients for midshaft clavicle surgery at a tertiary care center from October 2019 to May 2021. Specifically, this study aims to determine pain scores and opioid consumption (if there is any) of the patients who were given CPB with or without SCP block after clavicle surgery two hours at the recovery room and within 8 to 24 hours post-operatively and to determine if there is/are any adverse effects caused by the CPB and or SCP block (i.e., local anesthetic toxicity, puncture site bleeding or hematoma, peripheral nerve injury, etc) to the patients.

This article adheres to the applicable Enhancing the Quality and Transparency of Health Research (EQUATOR) Guidelines and Case Reports (CARE) Checklist.

Case Report

Seven patients who were electively scheduled for open reduction and internal fixation (ORIF) with plates and screws of the clavicle were identified as good candidates in this retrospective case series. Informed consent for anonymous use of patients' data

for publication and teaching purposes were obtained. The Makati Medical Center Institutional Review Board approved this case series with the following protocol number: MMCIRB 2021-047.

All peripheral nerve blocks done in this study were either performed or guided by an expert regional anesthesiologist who had already done approximately 10,000 nerve blocks. With direct supervision by the expert regional anesthesiologist, a fellow-in-training also performed some of the blocks.

Clavipectoral plane block (CPB) was done pre-operatively under minimal intravenous sedation with midazolam (2 to 5 mg) and fentanyl (50 to 100 mcg). Monitoring was set to five-minute intervals with supplemental oxygen at three liters per minute via nasal cannula.

On supine position, with head turned to the contralateral side, block was done under appropriate antisepsis. The affected clavicle was surrounded with sterile drapes. The high-frequency linear probe was covered with a sterile sonography cover. The probe was used to scan the length of the clavicle. It was initially placed 2 to 3 centimeters proximal to the fracture line to mark the first injection and a similar marking was done 2 to 3 centimeters distal from the fracture line to mark the second injection.

The periosteum of the clavicle and the surrounding fascia were both visualized for the proximal and distal injection sites. An in-plane technique was used to view the 80 mm ultrasound-visible stimulation needle advancing in a caudad to cephalad direction until it rests on the clavipectoral fascia.

Prior to injection of local anesthesia, aspiration was done. An injection pressure monitor attached to the syringe, objectively measured the injection pressure during administration of peripheral nerve blocks. The amount of local anesthetic (LA) mixture used in this block was 20 to 35 ml of 1:1 0.25% levo-bupivacaine with 1% lidocaine (10 to 17.5 ml per side of the fracture line). The same steps were followed in blocking the distal side of the fracture line.

In this retrospective case series, five patients were given SCP block after CPB. With the patient's head still turned to the contralateral side, the same sterile transducer was placed on the middle supraclavicular area to locate the brachial plexus, which is located lateral to the subclavian artery. Brachial plexus was traced upwards until it was seen at the interscalene groove between the anterior and middle scalene muscles. The transducer was overlying laterally to the sternocleidomastoid muscle approximately at the level of the cricoid cartilage or C6. The cervical plexus was visible as a small collection of hypoechoic nodules with honeycomb appearance located superficially to the prevertebral fascia. The needle was inserted in-plane with the transducer and passed through the skin, platysma and investing layer of the deep cervical fascia until it rests adjacent to the plexus. After negative aspiration, 2 ml of local anesthesia mixture (1:1 of 0.25% levo-bupivacaine with 1% lidocaine) was injected to confirm the proper injection site. The remainder 3 ml of LA mixture was injected to completely surround the plexus.

Discussion

We analyzed a total of seven patients who underwent ORIF of the clavicle, of whom two underwent CPB without SCP, and five underwent CPB with SCP block. Among the two patients under CPB, one was under sedation and one under general anesthesia. Both patients had pain after PACU discharge up to 24 hours after surgery, but none required opioid medications post-operatively. Among the five patients who had CPB with SCP block, four patients were under sedation and one under general anesthesia. All five patients had pain after PACU discharge up to 24 hours after surgery, and one patient previously under sedation had required opioid medication after PACU discharge.

Table 1 shows the patient characteristics (n=7) of this study. The patients had a median age of 39 years, ranging from 25 to 73 years old, and all were male patients. All but one patient was classified as ASA I. Five patients were under sedation and two were under general anesthesia. All patients were given lidocaine 1% with levo-bupivacaine 0.25%, at a median volume of 30 ml. During the PACU stay, pain scores were at zero, and there were no adverse events as shown in Table 2.

The median duration between PACU discharge and first post-operative pain reported was at 12 hours as shown in Table 3. None of the patients had any adverse event. There was one patient who required tramadol after PACU discharge.

Many authors believed that SCP is adequate to provide analgesia but not anesthesia in clavicle surgeries. The supraclavicular nerve (C3 to C4) of the superficial cervical plexus has been speculated to provide sensory coverage to the bony parts of the proximal clavicle [3]. For this reason, a CPB alone may not provide a sensory block over the surgical incision. Hence, an SCP block should be done in midshaft clavicle surgeries [4]. A superficial cervical plexus block was given in five patients (Case 1,4,5,6 and 7) for their midshaft clavicle surgeries aside from

CPB. Three of them tolerated clavicle surgery under sedation only while the remaining one was placed on general anesthesia due to inadequacy of sedation by dexmedetomidine infusion despite its maximum sedation dose at 0.7 mcg/kg/hr.

Table 1: Patient's characteristics (n=7).

	All (n=7)	CPB (n =2)	CPB + SCPB (n=5)
	Mean + SD; Median (Range); Frequency (%)		
Age, years	*39 (25-73)*	*56 (39-73)*	*32 (25-42)*
Gender			
Male	***7 (100)***	***2 (100)***	***5 (100)***
Female	***0***	***0***	***0***
Weight, kg	*71.84 ± 14.23*	*77.75 ± 13.08*	*69.48 ± 15.38*
Height, cm	*176.71 ± 4.79*	*178 ± 8.49*	*176 ± 3.90*
ASA Classification			
I	*6 (85.71)*	*1 (50.00)*	*5 (100)*
II	*1 (14.29)*	*1 (50.00)*	*0*
Anesthetic technique used			
Sedation	*5 (71.43)*	*1 (50.00)*	*4 (80.00)*
General Anesthesia	*2 (28.57)*	*1 (50.00)*	*1 (20.00)*
Type of anesthesia used			
lidocaine 1% + l-bupivacaine	*7 (100)*	*2 (100)*	*5 (100)*
Volume of anesthesia used, ml	*30 (20-35)*	*30 (30-30)*	*25 (20-35)*

*Note: Values are mean + SD or median (range); CPB – Clavipectoral plane block; SCPB – Superficial Cervical Plexus Block

Table 2: Pain scores and opioid consumption at PACU (n=7).

	All (n=7)	CPB (n=2)	CPB + SCPB (n=5)
	Mean + SD; Median (Range); Frequency (%)		
NRS			
1st hour	*0 (0-0)*	*0 (0-0)*	*0 (0-0)*
2nd hour	*0 (0-0)*	*0 (0-0)*	*0 (0-0)*
Adverse events during PACU stay	*0*	*0*	*0*
Rescue opioid medication given			
Tramadol	*0*	*0*	*0*
Oxycodone	*0*	*0*	*0*

*Note: Values are mean + SD or median (range); PACU – post-anesthesia care unit, CPB – Clavipectoral plane block; SCPB – Superficial Cervical Plexus Block; NRS – numeric rating scale

Table 3: Pain and opioid consumption after PACU discharge (n=7).

	All (n=7)	CPB (n=2)	CPB + SCPB (n=5)
	Mean + SD; Median (Range); Frequency (%)		
Duration between PACU discharge and first post-operative pain, hours	*12 (2-22)*	*12 (2-22)*	*12 (6-18)*
Adverse events within 24 hours after PACU discharge	*0*	*0*	*0*
Rescue opioid medication given			
Tramadol	*1 (14.29)*	*0*	*1 (20.00)*
Oxycodone	*0*	*0*	*0*

*Note: Values are mean + SD or median (range); PACU – post-anesthesia care unit, CPB – Clavipectoral plane block; SCPB – Superficial Cervical Plexus

Block.

Fig. 1 is a scatterplot of the pain scores of patients (Case 1,4,5,6 and 7) who received CPB-SCP block as measured thru numeric rating scale (NRS) in 24 hours after PACU discharge. All five patients had pain after PACU discharge up to 24 hours after surgery, and one patient (Case 4) previously under sedation had required opioid medication.

Conversely, no SCP block was done in Case 2 and 3, versus a skin infiltration on the surgical incision area that provided a sufficient sensory coverage of the field in the paper by Ince et al [1]. This infiltration potentially blocked the supraclavicular nerve, one of the innervations of the clavicle. Due to the proximity of CPB to the skin, the LA has diffused to the distal cutaneous branches of the clavicle that passes through the clavipectoral fascia. Consequently, the effectiveness of CPB in preventing pain was interesting because it did not require any SCP block [4]. After PACU discharge pain scores of Cases 2 and 3 (1-2/10 at 22nd hour and 2-3/10 at 18th hour, respectively) were mild even without the SCP block. Case 2 was the patient described in the paper by Rosales and Aypa [6] in 2021. When there is a possible break in the continuity of the fascia surrounding the fractured clavicle, a “hematoma block” or a local infiltration over the subcutaneous plane of the clavicle may be provided to avoid sparing of the block. Neither of these techniques was done in Case 2. In fascial plane blocks, integrity of the fascia and potentiality of the interfascial plane are two factors that must be considered in providing effective anesthesia. The fascial integrity is somehow lost by injury and trauma to the tissue by the surgical procedure itself [5]. However, in case 2, the trauma causing the fracture might consequently cause only a mild disruption in the fascial plane architecture. Therefore, the spread of local anesthesia was not compromised.

Fig. 2 is a scatterplot of the pain scores of patients (Case 2 and 3) who received CPB as measured thru NRS in 24 hours after PACU discharge. Both patients had pain after PACU discharge up to 24 hours after surgery, but none required opioid medications post-op.

Three patients (Case 2,3 and 5) were all given with CPB using 30 ml of local anesthesia mixture of lidocaine 1% and l-bupivacaine 0.25% (see Appendix B). The same volume and LA mixture were used by Ince et al [1], which produced post-operative pain scores of 0/10, 2/10, 3/10, 4/10, 2/10 and 3/10 at 1st, 2nd, 4th, 8th, 12th and 24th hour, respectively to a patient who underwent surgery of the left midshaft clavicle fracture. CPB was utilized both as anesthesia and analgesia.

Case 3 and 4 underwent clavicle surgery with CPB and general anesthesia. Though Case 3 has requested general anesthesia, Case 4 was placed on general anesthesia after administration of the combination block of clavipectoral plane-superficial cervical plexus due to inadequacy of anesthesia. CPB in Case 4 was completed with 20 ml of LA versus 30 ml of LA in Case 2. A high volume of LA is needed in order to have a good spread of LA between the space created by the periosteum of the clavicle and clavipectoral plane fascia. Anesthesia may be inadequate but analgesia was not compromised. Pain score on the 16th hour after PACU discharge of case 4 was NRS 1/10 meant a slight pain on the post-operative site. Hence, good pain control.

All blocks in seven patients were done pre-operatively and were used as anesthesia and analgesia versus the blocks that were performed post-operatively by Atalay et al [2] in five patients where CPB was used for analgesia only in clavicle surgery. CPB provided analgesia for an average length of between 12 and 22 hours with pain scores measured thru visual analogue scale (VAS) of between two and four [2].

This study avoided administration of general endotracheal anesthesia and consequent manipulation of airway in majority of the cases, except for Case 3 where a supraglottic device was used. In a study by Yoshimura and Morimoto [7], CPB and SCP blocks were performed after general anesthesia in a patient who does not have a good movement of the shoulder acquired from trauma and in a patient who has a chronic obstructive pulmonary disease. Both patients have clavicle fracture that needed surgical fixation procedure. Post-operatively, both patients did not experience any pain as measured thru VAS scores of 0/10 and 1-2/10, respectively. No analgesic medications were given to the patients until 13 hours post-operatively. Ueshima et al [8] did another study that placed a patient with coronary artery stenosis on general anesthesia first before giving a CPB. After induction, 30 ml of 0.25% of l-bupivacaine was equally injected medially and laterally to the clavicle fracture. No additional analgesia was given to the patient and the pain score of NRS 0/10 was maintained until 48 hours post-operatively.

This novel technique might be beneficial in trauma patients with multiple fractures of the clavicle and rib. Further expansion of existing pneumothorax in cases like this may be avoided by not giving general

anesthesia [1]. Hence, doing a peripheral nerve block, which is motor-sparing like the CPB is highly recommended to prevent further worsening of respiratory function.

There was no occurrence of any nerve block-related adverse events such as local anesthesia systemic toxicity, puncture site bleeding or hematoma and peripheral nerve injury in all seven cases included in the study. This study also avoided not only the upper extremity motor block but also the possible complications of doing an interscalene and cervical plexus block such as phrenic nerve paralysis, Horner's syndrome and epidural/vertebral artery injection. Because of its ease to perform and its superficial and lateral injection in reference with the clavicle, doing a clavipectoral plane block instead of an interscalene block has an advanced safety profile. Doing a brachial plexus block can block pain transmission more proximally since it is close to the neurovascular structures of the cervical spine and neck [4].

Clavipectoral plane block can be done by injecting 10 to 50 ml of long-acting local anesthesia into the fascia on both medial and lateral sides of the clavicle fracture. Also, this block must be used along with the block of the supraclavicle branch of the superficial cervical plexus to anesthetize the skin above the clavicle [5]. In our study, CPB was done by injecting a total of 20 to 35 ml of a combination of an intermediate and a long-acting local anesthetic agents into the proximal and distal sides of the clavicle fracture line while block of the superficial cervical plexus was done in five patients with the same LA mixture but only 5 ml. CPB done in seven patients for clavicle surgery provided anesthesia and analgesia that lasted between 9- and 28-hours post-block. The only patient that requested opioid, Case 6, was at nine hours post-block due to a NRS of 9/10 (see Appendix B). Majority of the patients were sent home the day after their surgery.

Larger prospective trial studies are needed to further illustrate the distribution of sensory blockade of CPB. We suggest doing a dose-finding study wherein different volumes of LA (10 ml, 12 ml, 15 ml and 17.5 ml) per side of the clavicle fracture line will be used. In this manner, we can determine the minimum volume of local anesthesia that can provide adequate anesthesia and analgesia since CPB is a plane block. Moreover, it would be helpful to compare clavipectoral plane block only versus clavipectoral plane block with superficial cervical plexus block as surgical anesthesia in midshaft clavicle surgeries. Converting to general anesthesia should be avoided as much as possible to further support the efficacy and safety of this block under intravenous sedation. We also recommend performing the superficial cervical plexus block prior to the clavipectoral plane block to provide immediate anesthesia on the puncture sites for the CPB.

Conflict of interest

The author declares no conflict of interest.

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