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CASE REPORT

Peripheral Nerve Block with Infraclavicular Block in Patient with Prior History of Cerebrovascular Accident: A Case Report

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ABSTRACT

Brachial plexus block via infraclavicular block using perineural local anesthesia for upper extremity surgery results in superior analgesia compared with the axillary or interscalene approach. Neurological disabilities, associated comorbidities, and the effects of both anesthesia and surgery make patients with a history of cerebrovascular accident (CVA) more susceptible to perioperative complications. An Indonesian man, 56 years-old, presented with vulnus schizum of the left wrist extensor zone VIII and malunion of the middle third of the left clavicle. The patient had a history of CVA 3 years ago. Debridement, exploration, tenorrhaphy when needed, and primary hecting were scheduled using peripheral nerve block anesthesia with infraclavicular block. The patient was stable post-surgery without any edema or complicated surgical wound. Experts recommend combining two modalities, such as ultrasound and nerve stimulator, to reduce the chances of complications. Peripheral nerve blocks with infraclavicular block are safe for patients with a history of CVA. Peripheral nerve blocks with the infraclavicular block are recommended in patients with traumatic hand injury with a history of CVA.

INTRODUCTION

Central neuraxial and peripheral nerve blocks are two categories of blocks. Peripheral nerve blocks are becoming increasingly popular due to their enhanced precision, effectiveness, and safety measures. The aim is to block the transmission of impulses further down the line, effectively interrupting the signal of pain that reaches the brain. Originally, peripheral nerve blocks involved locating peripheral nerves by inducing abnormal sensations, before eventually transitioning to using nerve stimulation methods. Depending on the type of injury, multiple nerves can be effectively blocked (Waloejo et al., 2024). During upper limb surgery, using the infraclavicular approach to the brachial plexus with perineural local anesthesia provides improved pain relief for the entire arm compared to the axillary or interscalene approaches (Suroto et al., 2019; Zaragoza-Lemus et al., 2015).

Patients with a history of cerebrovascular accident (CVA) are at risk for perioperative complications due to pre-existing neurological disability, co-morbidities, and the impacts of anesthesia and surgery. During the time before and after surgery, stroke patients are much more likely to experience worsening neurological issues and a subsequent stroke, with the chances being 6-12 times higher (Christi et al., 2021; Mehdi et al., 2016). Traditional methods have several drawbacks compared to peripheral nerve blocks (Christin et al., 2023). Patients with elevated risks under general anesthesia can safely proceed with surgery using regional anesthesia (Waloejo et al., 2024). Careful consideration of a patient's cerebrovascular reserve and the risks related to the surgery being considered can help lower complications during the perioperative period. The use of ultrasound guidance has enhanced the visualization of nerve structures and surrounding tissues, leading to improved outcomes in recent times (Knipfer et al., 2018). The report is based on Surgical Case Report (SCARE) Guidelines 2023 (Sohrabi et al., 2023).

PRESENTATION OF CASE

An Indonesian man aged 56 years was accidentally cut by a machete while cutting down tree branches, causing bleeding and pain on the left hand. There is no history of drug or food allergies. He had left-sided hernia surgery 6 months ago. There was no history of hypertension, renal failure, diabetes mellitus, or asthma. However, there is a medical history of cerebrovascular accident (CVA) 3 years ago.

The patient's vital signs were normal: GCS 456, blood pressure of 110/70 mmHg, pulse of 82 ×/min, respiratory rate of 20 ×/min, and SpO2 of 96% room air. On the initial physical examination, head, neck, thorax, heart, and abdomen were all within normal limits. The diameter of pupil is 3 mm right and left with positive light reflex. Left hemiparesis was observed. On the left-hand region, there was vulnus schism on the posterior side, size of 3×1 cm, with muscle base, minimal oedema, no visible tendons, and no active bleeding (Figure 1). There is tenderness, no hypoesthesia, and distal vasculature are within normal limits. Range of motion was limited due to pain. There is weakness in the left extremity with a motoric strength of +4.

Figure 1. Preoperative Clinical Findings Showed an Open Wound with Stopped Bleeding on the Left Hand

The patient was given metamizole of 1 gr/8 h, Tetagam of 250 UI, and Ceftriaxone 1 gr/12 h. Management includes debridement, exploration, tenorrhaphy as needed, and primary hecting with peripheral nerve block anesthesia with Infraclavicular block. ECG, x-ray and preoperative laboratory examinations were within normal limits. The individual was categorized as American Society of Anesthesiology (ASA) 3 and had a past medical event involving a CVA. Peripheral Nerve Block was conducted with Midazolam 1 mg and Fentanyl 25 mcg premedication. Infraclavicular block is performed by identifying the brachial plexus below the clavicle guided by ultrasound and stimuplex. Intermittent Midazolam 2 mg was given for intraoperative sedation.

The patient is prepared in a supine position. Freeze- or off-mode ultrasound was positioned contralateral to the block position. The block area was disinfected with 5% Povidine Iodine. The probe was positioned in the parasagittal plane to identify the axillary artery, followed by readjusting depth according to the thickness of the chest wall muscle. The probe was tilted to identify 3 hyperechoic structures of the brachial plexus cord (lateral, posterior, and medial cord; Figure 2). The target is 6 o'clock direction of the axillary artery in the posterior cord. Infiltration anesthesia is performed below the probe. The needle is inserted to the posterior cord until finger and wrist extension twitches followed by reducing stimuplex stimulation to 0.5 mA. Ropivacaine 0.5% 30 mL was administered.

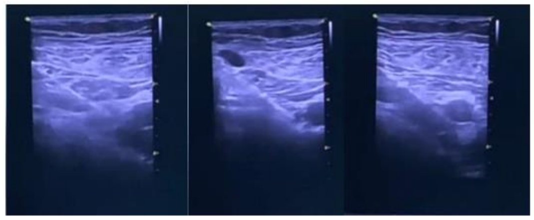

Figure 2. Ultrasound-Guided Images during Anesthesia Administration

Intraprocedural findings were intact radial superficial, total rupture of the left abductor pollicis longus (APL), partial rupture of the left extensor pollicis brevis (EPB), intact extensor carpi radialis longus (ECRL) and extensor carpi radialis brevis (ECRB), and incomplete radius fracture (Figure 3). Thus, debridement was performed with NaCl 0.9% of 6 L, exploration, left APL repair, left EPB repair, closed wound by each layer, and immobilised using a thumb spica splint. Intraoperative hemodynamic were stable with systolic of 118-133 mmHg, diastolic of 67-80 mmHg, mean atrial pressure (MAP) of 90-100 mmHg, and pulse of 81-106 ×/min. The duration of this surgery was 3 h.

Figure 3. Intraoperative Finding a Surgery Successfully

Postoperative planning includes monitoring vital signs every 15 min. Evaluation of the patient's sensory and motor hand function, signs of nerve injury, signs of local anaesthetic systemic toxicity (LAST), urine output every hour, post-surgical wounds, infection signs, and pain scale. Patients and families are educated regarding the patient's condition and the effects of anesthesia. Postoperative therapy consists of ringer lactate of 500 mL/day, Paracetamol of 1 gr, Ibuprofen of 3×400 mg/day (if the pain scale of >3), and normal diet planning. The post-surgical condition was stable without oedema or complicated surgical wounds. We did follow up several times in the first week post-surgery; the first month and 3 months post-op, the patient showed improvement, and no signs of complications were found.

RESULT AND DISCUSSION

Transmission of stimuli occurs when the cell membrane of neurons undergoes depolarization in a wave-like manner. LA prevents impulse conduction by blocking sodium channels. LA should be administered as close as possible while also taking care to avoid any risky contact with the needle. Regional anesthesia is more commonly utilized than general anesthesia in orthopedic surgeries, particularly those involving the extremities (Paśnicki et al., 2024). Peripheral nerve blocks help reduce the occurrence of postoperative pain and decrease the requirement for opioids and negative impacts of general anesthesia during surgery. The extended duration and gradual recovery of the blocks contribute to better pain management after the operation (Johnson et al., 2016).

It is important to use a strict sterile technique when administering blocks. Anxiolytic medications can be utilized to help ensure the patient's comfort during the procedure (Waloejo et al., 2024). Lidocaine, bupivacaine, and ropivacaine are the amide LA that are frequently utilized. Allergic responses are seldom triggered by these substances due to their excellent stability. It is recommended for healthcare professionals to administer the minimal effective dosage to obtain the desired outcome. The initiation of effect of local anesthesia is influenced by various factors, such as the method of administration and the quantity and strength employed (Table 1) (Midia & Dao, 2016). LA options for the infraclavicular block are short-acting (lidocaine 2%) or long-acting (bupivacaine 0.5%, levobupivacaine 0.5%, or ropivacaine 0.5%) according to the desired duration of the analgesia (Brown et al., 2022).

Table 1. Recommended dose and duration effect of local anesthetics used for peripheral nerve block (Midia & Dao, 2016)

Local Anesthetics	Recommended Dose Without and With Epinephrine	Duration (hours)	Maximum Dose
Prilocaine 1.5-2%	5 and 7 mg/kg	0.5-3	0.01-0.01 mL / mL of LA
Mepivacaine 1-1.5%	5 and 7 mg/kg	2-4	2-5 μg/kg
Lidocaine 1-1.5%	4.5 and 6 mg/kg	1-3	150-300 μg
Bupivacaine 0.25-0.5%	2.5 and 3 mg/kg	4-16	4-10 mg
Levobupivacaine 0.5-0.75%	2 mg/kg	14-17	0.5-1 μg/kg
Ropivacaine 0.5-1.0%	3.5 mg/kg	5-8	100-150 mg

The infraclavicular block is utilized for surgical procedures on the elbow, forearm, and hand. In contrast to the axillary block, this technique can be done without relocating the affected limb (e.g. post-injury) using a single injection method, making it a preferred choice for some anesthetists in surgeries involving these regions. Using ultrasound guidance in the pericoracoid region has made this block easier and more effective, while also lowering the chances of causing vascular puncture and pneumothorax. The main objective of establishing landmarks for the block is to visually locate the axillary artery and vein on a sonographic image in a cross-section (Brown et al., 2022). The most effective way to block pain with only one injection of 30 ml of LA is to inject it behind and surrounding the axillary artery (Raju & Bowness, 2019). The needle is inserted horizontally from above downwards, slightly below the collarbone, passing through the pectoral muscles and aiming towards the back of the axillary artery. When the fascia is penetrated by the needle, there is often a sensation of decreased resistance. If the nerve stimulator causes a motor reaction, it typically occurs in the lateral cord, leading to either elbow or finger flexion (Brown et al., 2022).

While peripheral nerve anesthesia is generally considered safe, there is still a possibility of experiencing neurological complications. When it comes to anesthesia for peripheral nerves and plexus, there is a reported incidence of neuropathy following a brachial plexus block at a rate of 2.84 per 100 cases (Paśnicki et al., 2024). The causes of peripheral nerve damage include chemical, physical, circulatory, and inflammatory factors. Injecting a local anesthetic directly into a nerve can harm it both physically (Christin et al., 2023) and by creating excessive pressure within the confined area enclosed by the protective epineurium (Vadhanan et al., 2015). To ensure effectiveness and safety, it is important to steer clear of important structures when inserting the needle, administer local anesthesia near the nerve but not within the epineurium to minimize the amount needed, and prevent direct nerve damage and the injection of anesthesia inside the nerve (Paśnicki et al., 2024; Sumarwoto et al., 2021).

In the beginning, regional anesthesia relied on surface and bone landmarks. Nevertheless, this approach frequently led to errors in needle placement. Numerous innovations have since been developed, such as monitoring injection pressure, using an electric nerve stimulator, and utilizing image guidance (Klein et al., 2012). A nerve stimulator is a tool that produces electric pulses with adjustable strength and rate. It is easier to locate the appropriate nerve structures using a unique needle that is insulated everywhere except the tip, by observing the muscle's motor response. Ultrasound imaging has enhanced the accuracy of both vascular cannulation and the execution of regional anesthesia. The use of direct anatomical visualization and accurate positioning of the needle has led to improvements in procedure efficiency, lower likelihood of nerve damage or medication errors, and decreased anesthesia volume. It is recommended by professionals to use a combination of ultrasound and nerve stimulation, also known as dual-guidance, for optimal results (Midia & Dao, 2016; Paśnicki et al., 2024).

Symptoms of systemic toxicity from LA can vary from mild to severe, affecting the central nervous system and the cardiovascular system. Important guidelines suggest having a 20% lipid solution ready when administering LA, using the smallest effective dose necessary, conducting test doses with aspiration and medications, and closely observing patients for any signs of trouble post-injection lasting over 10 minutes. Moreover, adjusting the needle position upon blood aspiration or when facing resistance, numbness, or pain during injection, can help prevent potential complications (Klein et al., 2012). Infraclavicular block does not have any specific contraindications related to specific blocks. However, peripheral nerve blocks have absolute contraindications such as patient refusal, allergic reactions to local anesthetics, and infections at the injection site. Relative contraindications for peripheral nerve blocks include coagulopathy and preexisting active neurologic deficits (Kaye et al., 2021).

Following an acute ischemic stroke, the ability of the brain to regulate blood flow is typically compromised on both sides for a period lasting 1-3 months, leading to a vulnerability to alterations in blood pressure and position that can impact cerebral perfusion. Vasomotor reactivity is also disrupted for about 3 months post-stroke, increasing the risk of ischemic events for individuals who have suffered a stroke. A previous history of stroke is the most common risk factor for experiencing a stroke during surgery. Anesthesia and surgery can disrupt heart function, brain activity, and oxygen levels, increasing the likelihood of another stroke even during less risky operations (Karnik & Jain, 2018). Patients who have suffered an ischemic stroke and have experienced significant improvement in their neurological deficits, such as hemiplegia, may see a recurrence of these deficits if they are exposed to benzodiazepines, opioids, or GA (Topcuoglu et al., 2017). There have been limited comparisons between general anesthesia (GA) and regional anesthesia (RA) for stroke patients. The existing evidence does not clearly show which technique is superior. Two studies suggest that GA may lead to more cerebrovascular events during surgery compared to RA in orthopedic procedures, but the number of patients with a history of stroke who experienced complications was not outlined in these studies (Memtsoudis et al., 2013).

CONCLUSION

Brachial plexus approach with infraclavicular block for upper extremity surgery result in superior analgesia compared to the axillary or interscalene approach. Direct visualization of anatomical structures and visualization of precise needle position improves block efficiency, reduces the risk of nerve injury or inappropriate drug administration, and reduces the volume of LA. A combination of two modalities, including ultrasound and nerve stimulators, has been recommended by experts. Peripheral nerve blocks are safe for patients with a history of CVA. His condition after surgery was stable and there was no edema or complication of the surgical wound.

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