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Case Report

Successful Reimplantation of Complete Mid Arm Amputated Upper Limb Aided by Supraclavicular Continuous Nerve Block

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ABSTRACT:
Continuous nerve block plays an important role in the event of reimplantation of amputated limbs and is beneficial in minimizing the amount of postoperative anesthetic and analgesic medication required, blocks the autonomic response of the vascular bed allowing for maximal vasodilatation of the re-connected vessels, hence improving patient outcomes and reducing healthcare costs.

Keywords: Reimplantation, Mid Arm, Supraclavicular Continuous

INTRODUCTION:

The reimplantation of a completely mid-arm amputated upper limb is a great medical achievement. This procedure not only demands extraordinary surgical precision but also relies significantly on advanced anesthetic techniques. The supraclavicular continuous nerve block has revolutionized the approach to perioperative and postoperative pain management, controlling the vasomotor effect and playing a crucial role in the overall success of limb reimplantation. Anesthesia in such procedures plays a very important role, as it enhances surgical outcomes, patient comfort, and long-term recovery [1, 2]. The reimplantation procedure is a race against time, including preservation of the amputated limb and the immediate stabilization of the patient vitally. The initial steps involve proper handling and cooling of the amputated limb to extend viability. Once the patient is prepared for surgery, the focus shifts to the operating room, where the anesthetic strategy plays a critical role ensuring the success of the procedure [3, 4].

The supraclavicular continuous nerve block is an advanced anesthetic technique that targets the brachial plexus nerves at the level of the supraclavicular fossa. There are advantages of this method over traditional general anesthesia, particularly in reimplantation procedures as by providing regional anesthesia, there will be complete blockage of the sensory pathway of entire upper limb, allowing for a pain-free post operative period without the systemic effects associated with general anesthesia. It also reduces the risk of respiratory depression, postoperative nausea and vomiting, and complications related to narcotic pain medications used during perioperative period, hence promoting a smoother surgical and postoperative course [5, 6].

Supraclavicular continuous nerve block offers significant benefits as it can provide prolonged pain relief. It ensures sustained analgesia, which is very important for patient comfort and early mobilization. Effective pain control is essential in the immediate postoperative period, as it reduces the physiological stress response to surgery, which can adversely affect the healing of reimplanted tissues by maintaining stable hemodynamics and providing continuous pain relief, the nerve block promotes optimal conditions for tissue viability and recovery [7, 8].

Early rehabilitation is facilitated by the supraclavicular continuous nerve block as pain is considered as significant barrier to mobilization and physical therapy, and inadequate pain control can lead to delayed recovery and poor outcomes. Providing effective and continuous analgesia makes patients be able to begin rehabilitation activities earlier, promoting the restoration of function and strength in the reimplanted limb. Also, Early mobilization is a critical factor in preventing joint stiffness, muscle atrophy, and other complications

increasing recovery time. [9], Insertion of Supraclavicular continuous nerve block requires experienced anesthetist and teamwork between anesthesia and surgical teams. Anesthesiologist has an important role in the perioperative period where he will ensure that the nerve block catheter is correctly placed, monitored, and adjusted according to the patient's need. That's why the presence of multidisciplinary teams, especially in complex surgical procedures, allows for successful outcomes and patient satisfaction. [11, 12].

In addition to its immediate benefits, the supraclavicular continuous nerve block also has positive implications for the long-term recovery and quality of life of patients undergoing limb reimplantation. Finally, effective pain management and early rehabilitation together will contribute to improved functional outcomes and will allow patients to regain independence and return to their daily activities. The psychological impact of limb loss and reimplantation is massive, comprehensive pain management support the emotional well-being of patients during their recovery period [13, 14].

Case Presentation:

A 27-year-old male patient brought by paramedics, fully awake, not in distress, with history of complete mid arm amputation above the elbow, left side tourniquet in place above the amputation site. Injury was sustained at work where he was involved in heavy machinery drilling for soil testing. Once the patient was received by the emergency department, the amputated arm was irrigated, cleaned and put on wet gauze and ice bag by emergency department staff, blood bank was notified for urgent issuing of blood units according to the patient group as the patient was vitally stable. Urgent referral to trauma, and vascular teams, reimplantation code was announced, decision taken to shift the patient to operation theater directly for surgical reimplantation. Once the reimplantation code was announced, anesthesia team attended the resuscitation room, the patient was quickly interviewed, and he was found to be medically free with no past medical or surgical history, and his last oral intake was 4 hours prior to the presentation.

Pre-procedural vitals were as follows: BP 125/80 mmHg, HR 80/min, RR 20/min, Temp 36 c, Spo2 96% on room air, tourniquet applied over the amputated arm at 250mmhg.

The patient shifted to the Operating theater where he was reassessed by the anesthetists in the theaters, patient has 2 intravenous cannulas in his limbs, an 18-gauge cannula in the right-sided metacarpal vein but slowly infusing fluids, another 20-gauge intravenous cannula in the right antecubital vein moving well. He was premedicated with Metoclopramide 10mg prior to induction, Sodium chloride 0.9% intravenously was started, patient was preoxygenated prior to induction up to End-tidal Oxygen levels of 95%, 2 yankauer suction kept ready.

Figure 1: Left upper limb completely amputated at mid arm level.

Patient was induced with 250 mcg of fentanyl, 150 mg of propofol and 100 mg of succinylcholine, to facilitate a rapid sequence induction, an endotracheal tube sized 8.0 mm was inserted successfully and uneventfully with the use of direct laryngoscope and aid of a stylet. Patient was maintained under anesthesia with Desflurane at 5.9% and given 80 mg of rocuronium for maintenance of muscle relaxation. Another two 16-gauge cannulas in the great saphenous veins bilaterally, 20-gauge arterial cannula in the right radial artery. An arterial blood gas was obtained meanwhile preparing for the peripheral nerve block. A left supraclavicular nerve catheter was inserted under the guidance of ultrasound, patient was in supine position, prepped with chlorhexidine and draped, while monitoring his heart rate and ECG, his respirations, his blood pressure invasively and overall general current condition.

Using a 22-Gauge, 5 centimeters long needle guided with ultrasound, without nerve stimulator in-view of the presentation of an amputated limb and relaxant being given, the needle was visualized in the targeted area, a multi-hole catheter was inserted with depth of 7 centimeters at skin level. Initiated with 20 ml of 0.75% Ropivacaine.

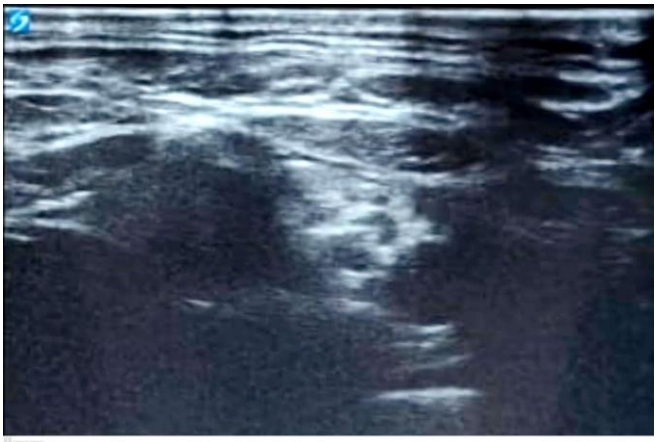

Figure 2: Ultrasound image of supraclavicular catheter after placement.

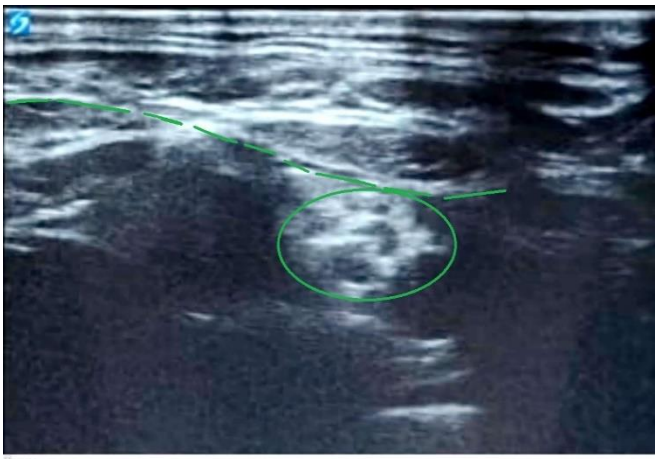

Figure 3: Ultrasound image marking the catheter site and brachial plexus.

Figure 4: Hand team preparing the amputated arm.

Patient received IV medications including (analgesics, antiemetics and NSAID) Paracetamol 1000 mg, Pantoprazole 40mg, Dexamethasone 8mg, Diclofenac 75 mg and Ondansetron 8 mg. The patient's urine output was monitored, and his fluids resuscitation was altered according to the hemodynamic status. Patient was hemodynamically stable all through the procedure requiring no inotropic or vasopressor support. Trauma team started first by clamping the main arteries and veins, released the tourniquet and started fixing the humerus by plate and screw, later after trauma team finished, vascular and hand team started debriding the necrotic tissue and preparing field for reimplantation meanwhile another team is working on the amputated limb to get it prepared. 1gm of calcium gluconate was given after arterial blood gases analysis. Later, required a top up of 100 mcg of fentanyl and 20 mg of rocuronium. 4 hours into the surgery he received 250 ml of packed red blood cells. Upon the surgeon's request he received 5000 IU of heparin, one hour later the patient received another unit of 250 ml of PRBCs. He required another 150 mcg of Fentanyl and 20 mg of Rocuronium.

Later, 1 gram of Calcium gluconate given according to ABG results. Later, the patient required 100 mcg of Fentanyl. Seven hours after initiation of the procedure 10 mg Morphine received. Again, 1gm Calcium gluconate after the blood gas analysis and his hemoglobin was 8.8 g/dL, discussed with the surgeons and the decision is to transfuse a unit of Packed Red Blood Cells given towards the 10th hour of the procedure. After the reimplantation was successfully done, trauma team rejoined again to do external fixation of the radius. Then the hand team continued skin closure.

The surgery was successful, arm was reimplanted, stoppage of anesthesia and reversal of muscle relaxant with 200 mg of Sugammadex then patient was extubated successfully and transferred to the Post-Anesthesia Care Unit uneventfully. Total urine output was 2200 ml, and blood loss was approximately 600 ml. Patient reports no sensory or motor function below the reimplantation line, no deficit above it, he is pain free.

Figure 5: Hand team started closing the wound after trauma team fixed the radius with external fixator.

Patient was discharged to high dependency ward with Supraclavicular Catheter with Ropivacaine 0.2% 5 ml basal rate, 5 ml bolus, lockout 30 minutes, max 30 ml/4 hours. Patient has consumed 45 ml by POD 1, on POD 3, patient complained of numbness and motor block above the reimplantation site, infusion was stopped for 6 hours until motor power recovered then basal rate was reduced

to 3 ml/hr and pump restarted, by POD 5 morning round was done and patient was fine with total consumption of 450 ml, discussion with surgeon was done for removal and was agreed to be removed, but accidentally when patient was moving to bathroom catheter got dislodged and was taken out, catheter tip was inspected and patient reassurance was done, patient was pain-free and has no complaints, medications were reconciled for proper analgesia and he was discharged from anesthesia side after 24 hours of catheter removal.

DISCUSSION:

The autonomic nervous system plays an important role in regulating the function of blood vessels. It is divided into two main branches (sympathetic nervous system and parasympathetic nervous system). Sympathetic Nervous System functions to constrict blood vessels to redirect blood flow to vital organs during stress response to increase blood pressure [14]. Parasympathetic Nervous System promotes relaxation and recovery by slowing heart rate and dilating blood vessels to improve blood flow to other organs [15]. Blood vessels receive innervation from both the Sympathetic and Parasympathetic nervous systems. where Sympathetic fibers release norepinephrine that binds to alpha-adrenergic receptors on the smooth muscle cells of blood vessels, causing vasoconstriction. Parasympathetic fibers release acetylcholine, which binds to muscarinic receptors on the smooth muscle cells, causing vasodilation. Regulation of Blood flow through arteries is regulated by a balance between both systems [16].

On the initial response to vessel Injury, endothelial cells lining the vessels get activated and start to release cytokines and chemokines that attract immune cells to the site of injury. Inflammatory Response then follows with Immune cells attraction to the wound site such as monocytes and T-lymphocytes, where they adhere to the endothelium and migrate into the arterial wall. This leads to inflammation which will help in the healing process [17]. Vascular smooth muscle cell activation in the arterial wall will respond to the injury by proliferating and migrating to the site of damage, they play a key role in stopping bleeding, repairing the arterial wall and formation of a new layer of cells [18].

Continuous Nerve blocks can modulate the autonomic nervous system by blocking nerve signals, this can prevent vasoconstriction and promote vasodilation through affecting the neurovascular Coupling of neuronal activity and blood flow. This leads to changes in blood vessel diameter to meet the metabolic demands of the tissue. Analgesic effect of continuous nerve block helps in reduction of Inflammatory response stimulated by release of pain-related neurotransmitters and inflammatory mediators [19]. Preemptive nerve block done by administering a nerve block before an injury or surgical procedure can reduce the inflammatory response and hyperalgesia after the procedure [20]. The continuous peripheral nerve block under local anesthesia has shown improved tissue perfusion following limb reimplantation surgery. This technique is particularly helpful to prevent vasospasm in the reconstructed tissues during the postoperative period [21].

Furthermore, the use of continuous peripheral nerve block is the ideal method for post-operative pain management, as it enhances the recovery period in sense of analgesia plane that is continuous, improving the quality of sleep and improving the satisfaction of the patient [22].

CONCLUSION:

Insertion of supraclavicular continuous nerve block showed to have an integral impact on the success rate of limb reimplantation procedure. This was achieved by providing effective and sustained pain relief, reducing the risks associated with narcotics-based post operative pain management, facilitating early mobilization and rehabilitation. This advanced technique enhanced the surgical outcome, promoted the overall recovery rate and improved the quality of patient's life. The success rate of such procedures is attributed to the new advancements in anesthetic and surgical techniques, along with the importance of coordinated and cooperative multidisciplinary teams [2, 13].

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