Case Report

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A Case of Upper Limb Amputation Managed with USG-guided Continuous Infraclavicular Nerve Block for Improved Postoperative Analgesia

Anaesthesia Section

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ABSTRACT

Phantom Limb Pain (PLP) is defined as any perceived painful sensation localised to the region of the amputated body part, while phantom limb sensations are non painful sensations emanating from the phantom limb, including proprioceptive awareness, kinetic, exteroceptive, and superadded sensations. The mode of anaesthesia administered during amputation is an important factor in determining the emergence of PLP or phantom sensations. The majority of patients requiring emergency care are victims of traumatic injuries to the upper limbs, which are most often treated conservatively. The authors present the case of a 67-year-old male patient who sustained a fall on his arm while carrying a metal container, resulting in a laceration to his left arm that led to disruption of brachial artery blood flow, necessitating amputation. Although upper limb injuries are relatively common, concurrent vascular injuries are rare. However, when a major vessel such as the brachial artery is injured, amputation may be required. This loss of a limb can result in PLP. To prevent this, the authors used a unique and rare protocol of Continuous Peripheral Nerve Block (CPNB) in the present case. It not only underscored the importance of intraoperative analgesia in preventing PLP but also proved to be a crucial anaesthetic tool in facilitating the surgery and providing the patient with a more comfortable postoperative recovery.

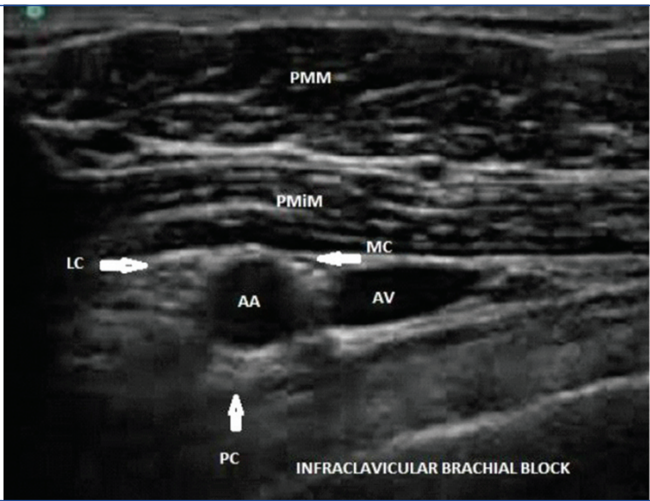
Keywords: Injury, Pain, Phantom limb, Recovery, Sensations, Ultrasonography

CASE REPORT

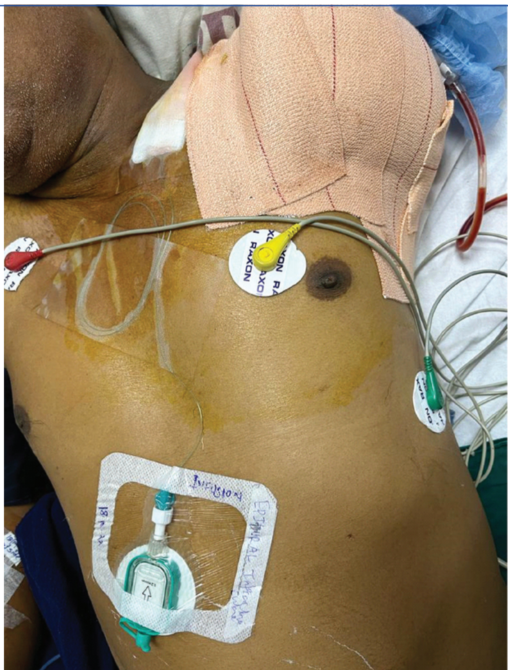
A 67-year-old male patient {American Society of Anaesthesiologists (ASA II), 170 cm, 70 kg} sustained an injury to his left arm following a reported slip and fall while climbing a ladder with a metallic container in his hand. The force of the impact injured the inner aspect of his left arm. There was no history of head injury or Ear, Nose, Throat (ENT) bleed. The patient was taken to a nearby hospital, where he received basic first aid and stabilisation with a transfusion of one unit of Packed Red Blood Cells (PRBC). Upon arrival at the emergency department, the patient was maintaining a pulse rate of 117 bpm, room air saturation of 98%, and a blood pressure of 70/50 mmHg. He had already been started on an inotropic infusion (Inj. Noradrenaline) for hypotension at the outside hospital. Although conscious and oriented, he was unable to move the fingers of his left hand, and the peripheries of his left upper limb were cold. The left radial and ulnar pulses were not palpable. No other visible injuries to the head, neck, or other limbs were observed. Upon removing the dressing, an 8×4 cm deep lacerated wound was revealed on the medial side of the hand. Left upper limb angiography was performed for further evaluation, which revealed absent flow in the brachial artery for about a 3-4 cm segment in the left upper arm region and likely thrombosis at the site of the injury. After appropriate clinical and radiological evaluations [Table/Fig-1], the patient was scheduled for an above-elbow amputation under General Anaesthesia (GA) with an infraclavicular block on the third day postinjury. On the day of surgery, after confirming the patient's consent, blood availability, and fasting status, the patient was taken to the operating room where all routine monitors were attached and a patent Intravenous (i.v.) access was secured. The patient was premedicated with IV glycopyrrolate and midazolam, preoxygenated with an anatomical face mask and 100% oxygen, administered Inj. fentanyl, induced with Inj. propofol and Inj. suxamethonium, and intubated orally with a size 8 cuffed endotracheal tube. After checking air entry, the tube was secured, and Inj. Vecuronium was administered for maintenance. The patient's head was then turned to the opposite side (right) for the block. The skin was painted and draped, and under all aseptic precautions, using the ultrasound probe, the authors visualised the infraclavicular brachial plexus. To localise the plexus, a high-frequency linear probe was used from the center of the coracoid process and the clavicle, utilising ultrasound in the infraclavicular region. A small curved array probe is also used by some anaesthetists. In this patient, sonography simplified the process of blocking the plexus. The probe was positioned caudal to the clavicle in a parasagittal orientation just medial to the coracoid for optimal visualisation. The artery was clearly visualised deep to the pectoralis minor muscle. The posterior, lateral, and medial cords appeared as hyperechoic structures (nerves) at the posterior, cephalad, and caudal areas, respectively, close to the artery [1,2]. The parasagittal plane was used to introduce the 18G needle, which

[Table/Fig-1]: Vascular upper-extremity computed tomography angiography revealed no flow in the brachial artery in the upper arm.

was then directed posterior to the artery. The optimal site for injecting local anaesthesia is just beneath the skin. Better visualisation and access to the plexus are relatively easy when the arm is retracted outward (abducted) [3]. Visualisation of the plexus is enhanced after the injection of local anaesthetic due to the creation of an echogenic window. The 18G needle was inserted parallel to the sonography probe while visualising the entire length of the needle. After ensuring proper negative aspiration through the needle, the epidural catheter was introduced, and the alignment of the catheter tip was verified at the center of the brachial plexus by injecting normal saline. The catheter was fixed after needle removal. A total of 30 mL of medication, comprising 15 mL of 0.5% bupivacaine and 15 mL of 2% lignocaine, was administered, and the drug's distribution was verified on the Ultrasonography (USG). All the divisions of the brachial plexus were seen to be surrounded by the local anaesthetic [Table/Fig-2]. The patient was then monitored in the postoperative period for pain assessment, and as soon as the patient was shifted to recovery postextubation, the Visual Analogue Scale (VAS) score was zero. Regular top-ups were administered through the catheter at a dose of 6 cc of 0.25% bupivacaine every 6 hours [Table/Fig-3]. Pain scoring was assessed with each top-up, which had an average VAS of 2/10. The catheter was removed on day 6 postsurgery, and the patient was discharged three days later.



[Table/Fig-2]: Infraclavicular brachial block.
PMiM: Pectoralis minor muscle; PMM: Pectoralis major muscle; AV: Axillary vein; AA: Axillary artery; PC: Posterior cord of plexus; MC: Medial cord of plexus; LC: Lateral cord of plexus



[Table/Fig-3]: Postoperatively the patient was having the continuous infraclavicular catheter in-situ.

The patient was followed-up for eight months and experienced a comfortable recovery. He reported no abnormal or unpleasant sensations or pain in the amputated limb. He was able to overcome his loss and was attempting to return to his normal daily activities without much difficulty.

DISCUSSION

Phantom limb sensation is a painful or uncomfortable feeling in the area of the missing or injured body part [4]. It is estimated that approximately 80-100% of amputees experience phantom limb sensation, which often follows a chronic course resistant to medical treatment [5]. PLP usually occurs within six months of amputation [6,7], and its prevalence has been reported to vary widely [8-10]. Over a 3-month period, the prevalence of PLP varied between 49% and 93.5% in different populations and was as high as 76%-87% over a lifetime [11]. According to two recent studies, the incidence of PLP was found to be 41% at three months and 82.7% at 12 months postamputation [12,13]. Risk factors for PLP include preoperative pain, the cause of traumatic amputation, and the type of anaesthetic technique used during amputation [14-16]. Studies indicate a significant increase in the incidence of PLP shortly after amputation surgery performed using only GA [1,17]. In the first week postsurgery, epidural anaesthesia and Peripheral Nerve Block (PNB) are seen to help reduce discomfort by preventing the onset of central sensitisation of pain [1]. A single-shot PNB may provide relief during surgery but has no significant effect on postoperative recovery as the pain persists once the block's effect wears off. In an attempt to provide the patient with adequate intraoperative analgesia and to reduce the chances of postoperative PLP, the authors present this case in which the patient received a USG-guided continuous infraclavicular PNB.

An infraclavicular block can be used for upper limb surgeries proximal to the mid-humeral level [18]. Since the nerve plexuses are most tightly packed at the level of the brachial trunks formed by C5-T1 nerve roots, blocking at this site has the highest chance of impairing all or most brachial plexus branches [19,20]. With the exception of the shoulder region, the infraclavicular block has a rapid onset and provides good analgesia during surgery of the upper extremity and even during recovery [21]. This block can be administered using a nerve stimulator following anatomical landmarks, or it can be performed under sonographic guidance, which may or may not involve a nerve stimulator.

The serious adverse effects of the anatomical landmark-guided technique include diaphragmatic hemiparesis resulting from phrenic nerve block, which affects 50% of patients, and pneumothorax, which occurs in 1-4% of patients [22]. The risk of pneumothorax is reduced with sonography guidance as it provides a clear view of the pleura and the first rib, helping the administrator ensure the needle does not pierce it. Amputees who received GA during surgery had the highest incidence of PLP.

Millions of amputees who underwent surgery with GA or a single-shot PNB suffer from PLP, and this prevalence is expected to increase. This persistent, intractable pain negatively impacts the quality of life, the likelihood of returning to work, and the risk of depression [23]. Several trials are underway to guide the treatment of established PLP [4,24]. It is better to act before neuronal changes lead to the development of PLP. The exact cause of phantom pain is still unknown, but research suggests that severing a peripheral nerve alters the somatosensory cortex, thalamus, and spinal cord, and this brain reorganisation results in phantom pain [25]. Therefore, according to the present case, PNB may be preferable over GA, or a combination of the two, to lower the risk of PLP in order to prevent the neuronal changes that eventually lead to its development. The effects of a single-shot PNB resolve within a few hours after administration, and the patient starts to experience pain at the surgical site, thereby increasing the chances of developing PLP.

Continuous PNB, used in the present case, provides the patient with effective intraoperative pain relief and postoperative comfort, thus decreasing the incidence of PLP.

CONCLUSION(S)

One of the most important factors in preventing the development of PLP is perioperative pain management. Continuous PNB may be the preferred technique over GA or single-shot PNB for lowering the risk of PLP. To confirm the effect of continuous PNB on the incidence of PLP and to establish it as a proper protocol for amputation surgeries, further large clinical studies and research are required. Larger comparative studies on continuous PNB versus GA or single-shot PNB in amputation surgeries will provide further evidence and give a clearer idea of the better approach for reducing the incidence of PLP.

REFERENCES

[1] Dingemans E, Williams SR, Arcand G, Philippe C, Patrick H, Monique R, et al. Neurostimulation in ultrasound-guided infraclavicular block: A prospective randomized trial. Anesth Analg. 2007;104(5):1275-80.
[2] Bloc S, Garnier T, Komly B, Asfazadourian H, Leclerc P, Mercadal L, et al. Spread of injectate associated with radial or median nerve type motor response during infraclavicular brachial plexus block: An ultrasound evaluation. Reg Anesth Pain Med. 2006;32:130-35.
[3] Bigeleisen P, Wilson M. A comparison of two techniques for ultrasound-guided infraclavicular block. Br J Anaesth. 2006;96(4):502-07.
[4] Hsu E, Cohen SP. Postamputation pain: Epidemiology, mechanisms, and treatment. J Pain Res. 2013;6:121-36. Doi: 10.2147/JPR.S32299.
[5] Sherman RA, Sherman CJ. Prevalence and characteristics of chronic phantom limb pain among American veterans. Results of a trial survey. Am J Phys Med. 1983;62(5):227-38.
[6] Montoya P, Larbig W, Grulke N, Flor H, Taub E, Birbaumer N. The relationship of phantom limb pain to other phantom limb phenomena in upper extremity amputees. Pain. 1997;72(1-2):87-93. Doi: 10.1016/S0304-3959(97)00004-3.
[7] Kooijman CM, Dijkstra PU, Geertzen JH, Elzinga A, van der Schans CP. Phantom pain and phantom sensations in upper limb amputees: An epidemiological study. Pain. 2000;87(1):33-41. Doi: 10.1016/S0304-3959(00)00264-5.
[8] Sherman RA, Sherman CJ, Parker L. Chronic phantom and stump pain among American veterans: Results of a survey. Pain. 1984;18(1):83-95. Doi: 10.1016/0304-3959(84)90128-3.
[9] Davis RW. Phantom sensation, phantom pain, and stump pain. Arch Phys Med Rehabil. 1993;74(1):79-91.
[10] Dijkstra PU, Geertzen JH, Stewart R, van der Schans CP. Phantom pain and risk factors: A multivariate analysis. J Pain Symptom Manage. 2002;24(6):578-85. Doi: 10.1016/S0885-3924(02)00538-9.
[11] Stankevicius A, Wallwork SB, Summers SJ, Hordacre B, Stanton TR. Prevalence and incidence of phantom limb pain, phantom limb sensations and telescoping in amputees: A systematic rapid review. Eur J Pain. 2021;25(1):23-38.
[12] Bhatnagar S, Ahmed A, Mishra S, Khurana D, Joshi S, Ahmad S. Prevalence of phantom limb pain, stump pain, and phantom limb sensation among the amputated cancer patients in India: A prospective, observational study. Indian J Palliat Care. 2017;23(1):24.
[13] Larbig W, Andoh J, Huse E, Stahl-Corino D, Montoya P, Seltzer Z, et al. Pre- and postoperative predictors of phantom limb pain. Neurosci Lett. 2019;702:44-50. Doi: 10.1016/j.neulet.2018.11.044. Epub 2018 Nov 29. PMID: 30503915.
[14] Hanley MA, Jensen MP, Smith DG, Ehde DM, Edwards WT, Robinson LR. Preamputation pain and acute pain predict chronic pain after lower extremity amputation. J Pain. 2007;8(2):102-09. Doi: 10.1016/j.jpain.2006.06.004.
[15] Karanikolas M, Aretha D, Tsolakis I, Monantera G, Kiekkas P, Papadoulas S, et al. Optimized perioperative analgesia reduces chronic phantom limb pain intensity, prevalence, and frequency: A prospective, randomized, clinical trial. Anesthesiology. 2011;114(5):1144-54. Doi: 10.1097/ALN.0b013e31820fc7d2.
[16] Ong BY, Arneja A, Ong EW. Effects of anesthesia on pain after lower-limb amputation. J Clin Anesth. 2006;18(8):600-04. Doi: 10.1016/j.jclinane.2006.03.021.
[17] Sahin SH, Colak A, Arar C, Tutunculer E, Sut N, Yılmaz B, et al. A retrospective trial comparing the effects of different anesthetic techniques on phantom pain after lower limb amputation. Curr Ther Res Clin Exp. 2011;72(3):127-37. Doi: 10.1016/j.curtheres.2011.06.001.
[18] Li J, Szabova A. Ultrasound-guided nerve blocks in the head and neck for chronic pain management: the anatomy, sonoanatomy, and procedure. Pain Physician [Internet]. 2021;24(8):533-48.
[19] Mejia J, Iohom G, Cuñat T, Flò Csefkó M, Arias M, Fervienza A, et al. Accuracy of ultrasonography predicting spread location following intraneural and subparaneural injections: A scoping review. Minerva Anestesiologica [Internet]. 2022 Mar 1 [cited 2023 Nov 6];88(3):166-72.
[20] Jones MR, Novitch MB, Sen S, Hernandez N, De Haan JB, Budish RA, et al. Upper extremity regional anesthesia techniques: A comprehensive review for clinical anesthesiologists. Best Pract Res Clin Anaesthesiol. 2020;34(1):e13-29.
[21] Infraclavicular Block [Internet]. The American Society of Regional Anesthesia and Pain Medicine (ASRA). Available from: https://www.asra.com/news-publications/asra-updates/blog-landing/legacy-b-blog-posts/2019/08/07/infraclavicular-block.
[22] Mak PH, Irwin MG, Ooi CG, Chow BF. Incidence of diaphragmatic paralysis following supraclavicular brachial plexus block and its effect on pulmonary function. Anaesthesia. 2001;56(4):352-56.
[23] Becker N, Bondegaard TA, Olsen AK, Sjogren P, Bech P, Eriksen J. Pain epidemiology and health related quality of life in chronic non-malignant pain patients referred to a Danish multidisciplinary pain center. PAIN. 1997;73(3):393-400.
[24] Richardson C, Kulkarni J. A review of the management of phantom limb pain: Challenges and solutions. J Pain Res. 2017;10:1861-70.
[25] Flor H, Elbert T, Knecht S, Wienbruch C, Pantev C, Birbaumer N, et al. Phantom-limb pain as a perceptual correlate of cortical reorganization following arm amputation. Nature. 1995;375(6531):482-84.

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