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CASE REPORT / ПРИКАЗ БОЛЕСНИКА

Hand replantation surgery in regional anesthesia – report of two cases

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SUMMARY

Introduction Hand replantation is a microsurgical operation on completely or incompletely amputated hand during which the soft tissue and bone structures are reanastomosed and reconstructed. Blockade of peripheral nerves provides anesthesia and analgesia, but also a sympatholytic effect, improving blood flow and offering better perfusion of the replanted tissue. The aim of this paper is to show the importance of regional anesthesia for hand replantation surgery.

Case report Two male patients sustained a traumatic amputation of the hands by working on industrial machines. The patients underwent a microsurgical hand replantation. An ultrasound-guided brachial plexus block was performed through an axillary approach. A 22G, 10 cm needle was used. Bupivacaine 0.25% 30 ml and lidocaine 1.3% 30 ml without adrenaline were injected perineurally. The medial side of the upper arm was infiltrated with lidocaine since it is the area of intercostobrachial nerve innervation that remains unaffected by the brachial plexus block, preventing the pain caused by the pressure from the tourniquet. During the operation, the patients were sedated with midazolam. Postoperatively, the patients were under observation at the Intensive Care Unit. Analgesia was maintained with intravenous nonsteroidal anti-inflammatory drugs and tramadol, and a single-shot blockade of brachial plexus, intramuscular groove approach. Laboratory tests were conducted, and every three hours, the skin color and turgor, capillary refill, and tactile temperature were monitored.

Conclusion Reducing peripheral vascular resistance, preventing vasospasm, and increasing blood flow through the anastomoses increase the chance of successful replantation and reduce postoperative pain and anxiety, which overall affect patients function and comfort.

Keywords: brachial plexus blockade; hand injury; microsurgery

INTRODUCTION

Hand replantation is a microsurgical operation on a completely or incompletely amputated hand during which the soft tissue and bone structures are reanastomosed and reconstructed [1]. If the amputation is limited to one limb, it is convenient to operate under regional anesthesia, which creates good perioperative conditions and adequate pain control after the operation [2].

Peripheral nerve block provides anesthesia, analgesia, and a sympatholytic effect, improving blood flow and offering better perfusion of the replanted tissue [2]. In this way, sympathetic blockade leads to an increase in venous diameter and causes an increase in blood flow through arterial blood vessels during the operative and postoperative periods [3]. The goal of replantation surgery has changed over time, from establishing the circulation of the replanted part to establishing the anatomical and aesthetic and finally the functional role of the amputated part of the body, in this case, the hand.

In this article, we present the cases of two patients with traumatic hand amputations and indicate the importance of regional anesthesia in replantation microsurgery of the upper extremity.

CASE REPORT

Two male patients, 62 and 74 years old, sustained a traumatic amputation of the hands by working on industrial machines on the day of admission (Figure 1). Initial wound management and amputated segment preservation were made adequately in the regional medical center. On admission, patients were conscious, hemodynamically, and respiratory stable. Upon admission, anesthesiologic and surgical planning was done after immediate radiological and laboratory evaluation. The patients underwent a microsurgical hand replantation in the first three hours after injury.

The patients were premedicated with midazolam intramuscularly (0.10 mg/kg). Two intravenous cannulas were placed. Standard non-invasive monitoring was conducted, non-invasive blood pressure measurement in the contralateral arm, pulse oximetry, and continuous electrocardiogram were attached to the patient. Crystalloid infusions, proton pump inhibitors (pantoprazole 40 mg by intravenous injection), and antibiotic (first-generation cephalosporin – cefazolin, 50 mg/kg/day intravenously) and anti-tetanus serum (1500 U intramuscularly) were started. An ultrasound-guided (eZono®4000, eZono AG, Jena, Germany) brachial plexus block was performed through an

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axillary approach (Figure 2). The patients were placed in the supine position, head turned to the opposite side, injured arm abducted up to 90°, elbow flexed, and forearm in external rotation. The linear probe was transferal over the upper arm's anteromedial part (Figure 3). The axillary artery was identified as a pulsating hypoechoic structure with a vein placed medially. The nerves were identified as hyperechoic structures surrounding the artery. A 22G, 10 cm needle (Stimuplex® Ultra 360® 22 Ga, B. Braun, Melsungen, Germany) was used. Bupivacaine 0.25% 30 ml and lidocaine 1.3% 30 ml without adrenaline were injected perineurally. The medial side of the upper arm was infiltrated with lidocaine since it is the area of the intercostobrachial nerve innervation that remains unaffected by the brachial plexus block, preventing the pain caused by the pressure from the tourniquet. During the operation, the patients were sedated with intravenous boluses of midazolam (0.02 mg/kg) and fentanyl (1 μg/kg) while maintaining spontaneous breathing, oxygen 6 L/min face mask was administered, and intravascular volume was maintained with crystalloids (lactated Ringer's solutions and sodium chloride 0.9%) and colloid (human albumin 5%) infusions. Bones were reduced and fixed with K-wires, blood vessels were anastomosed, and direct suture of tendons and nerves was performed (Figure 4). After identifying the arteries, the tourniquet deflated, Heparin 5000 U was given intravenously, and continuous infusion of Heparin 25,000 U was continued (Initially 3 ml/h, then corrected based on the activated partial thromboplastin time value, which was measured every four hours, aiming to achieve activated partial thromboplastin time 50–70 s). Postoperatively, the patients were observed at the Intensive Care Unit where they were kept normotensive, with an operated arm in an elevated position, above the level of the heart. Analgesia was maintained with intravenous nonsteroidal anti-inflammatory drugs, most often diclofenac (75 mg given intravenously every 12 hours) or ketorolac (30 mg intravenously every 12 hours), tramadol (100 mg given intravenously every 12 hours), and a single-shot blockade of brachial plexus, intramuscular groove approach, with 15 ml bupivacaine 0.125%. The patients

Figure 1. Preoperative view of amputated hand

Figure 2. Performing an ultrasound-guided (eZono®4000) brachial plexus block

Figure 3. The axillary approach performing brachialis plexus block

Figure 4. Postoperative aspect after reconstruction

were under observation, laboratory tests were conducted, and every tree hours skin color, turgor, capillary filling, and tactile temperature were monitored. Dressings were changed at least once daily. After 72 hours, the patients were transferred to the plastic surgery ward, with the continuation of anticoagulant therapy, which was gradually reduced, and aspirin (100 mg orally) prophylaxis started on the 10th postoperative day to prevent arterial occlusion. After 21 days, at discharge, both patients had vital hands with preserved motor function. The wounds healed without signs of infection.

Written consent to publish all shown material was obtained from the patients. Ethical approval was obtained by the institutional Ethics Committee (I-87/20). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration.

DISSCUSION

Upper extremity amputations account for more than 65% of traumatic amputations. It occurs more often in men (80%). Based on research, traumatic limb amputations are most often caused by chainsaws and circular saws in 41%, followed by axes in 14.6%. Amputation represents a significant loss for the patient, both physically and mentally, so the treatment of such injuries requires a multidisciplinary approach [4].

Regional anesthesia provides adequate conditions for hand surgery. The block interrupts the sympathetic innervation of the upper limb, which improves blood flow through the arterial blood vessels and causes an increase in venous capacity. This is essential in microvascular surgery because it can improve the possibility of survival of borderline viable tissues and increase the flow of microvascular arterial anastomoses [5]. Sympathetic vasoconstrictor nerve fibers are located in the distal arterial blood vessels of the hand, which is the reason for the frequent appearance of vasospasm in microsurgery of the hand [6]. Thrombosis of vascular anastomoses is the most common cause of failure in microsurgery [7]. Maintenance of adequate blood flow can prevent thrombosis and early failure in microsurgery [3, 8]. Pain after surgery, emotional problems, fear, agitation, and worry are the most important causes of vasospasm. Compared to general anesthesia, blocking the upper extremity with sympathicolysis prevents vasospasm, leading to vasodilatation, consequently preventing blood flow reduction and establishing adequate tissue perfusion [9].

Furthermore, it is a very good method for postoperative pain control, improving sleep quality and overall patient satisfaction [6]. Regional anesthesia may lead to reduction in systemic analgesic requirements, opioid-related side effects and the development of chronic postoperative pain [10]. A reduction of opioids, caused by brachial plexus block, may also decrease the incidence for opioid-induced nausea and vomiting, sedation, hypotension, bradycardia, respiratory depression, biliary colic, urinary retention. Wenger et al. [11] performed a study in which they noninvasively measured the change in blood flow and oxygen saturation in the hand after axillary block and came to the conclusion that axillary block improves oxygen saturation of peripheral tissues six hours after the start of anesthesia, which is of crucial importance for critically perfused tissues. Increased blood flow with reduced prothrombotic coagulation factors are the most important advantages of regional anesthesia techniques that make microsurgery successful [12, 13]. Regional anesthesia has negligible impact on the vital organs, which makes it safer for patients with existing comorbidities. After surgery, patients are awake and have a clear mind, protective reflexes of the upper respiratory tract are present, and, compared to general anesthesia, there are fewer complications such as somnolence, nausea, vomiting, atelectasis, and agitation. Blockade of the brachial plexus through the axillary approach avoids the possibility of anesthetic spreading into the epidural or subarachnoid space, paralysis of the diaphragm, hoarseness, Horner's syndrome, and pneumothorax. Disadvantages of regional anesthesia are the possibility of puncturing blood vessels and consequently the accidental application of local anesthetic intravascularly, the possibility of a toxic reaction, fear of stings and pain, and discomfort due to the presence of noise in the operating room [1, 14]. Regional anesthesia avoids the complications and risks of general anesthesia. Ultrasound-guided regional anesthesia increases the chance of success of the block [14].

Brachial plexus block anesthesia is the most common method for patients who undergo a replantation of a severed hand. This technique is widely used for upper limb surgery, due to fewer complications. The requirements for anesthesia are simple operation, minor impact on the patient's physiological functions, complete immobilizations, painless and postoperative analgesia, easy monitoring, and achieving vasodilatation of distal small vessels. General anesthesia is the method of choice in case of patient refusal of peripheral nerve block, skin infection at the injection site, uncooperative patients, patients with multiple serious injuries, an allergy to local anesthetics, long-term surgery, pediatric, bleeding disorders, dementia and other mental illness [1, 15].

Regarding the choice of local anesthetics, our decision was a combination of diluted bupivacaine 0.25% and lidocaine 1.3%, without the addition of adrenaline. Adrenaline, with its vasoconstrictor effect, reduces the absorption rate and prolongs the effect of local anesthetics. The use of solutions containing adrenaline can reduce blood flow through blood vessels [6, 16]. When it is important that the total blood flow through the extremities does not decrease, adrenaline should be avoided. Also, local anesthetics may delay the onset of block [17].

Postoperative care and rehabilitation are very important for achieving a high success rate. Changes in skin color and temperature, turgor, and slowed capillary refill can indicate even the smallest changes in the replant [18].

Hand amputation limits the patient's physical, psychological, social, and professional life. The survival of the replant depends on the success of the vascular anastomoses. Reducing peripheral vascular resistance, preventing vasospasm, and increasing blood flow through the anastomoses increase the chance of successful replantation and reduce postoperative pain and anxiety, which overall affect patients' function and comfort, which is made possible by the application of regional anesthesia. Adequate regional anesthesia and sedation calm the patient, provide suitable conditions for the surgeon's work, and ensure postoperative requirements, providing analgesia and vasodilatation.

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Реплантација шаке у регионалној анестезији – приказ два случаја

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САЖЕТАК

Увод Реплантација шаке је микрохируршка операција потпуно или непотпуно ампутиране шаке, током које се реанастомозују и реконструишу коштане и мекоткивне структуре. Блокада периферних нерава обезбеђује анестезију и аналгезију, али и симпатолитичко дејство, побољшава проток крви и пружа бољу перфузију реплантираног ткива.

Циљ овог рада је приказати значај регионалне анестезије за реплантациону хирургију шаке.

Приказ болесникâ Два мушка пацијента доживела су трауматску ампутацију руку радећи на индустријским машинама. Пацијенти су подвргнути микрохируршкој реплантацији шаке у прва три сата после повреде. Ултразвучно вођен блок брахијалног плексуса урађен је аксиларним приступом. Коришћена је игла од 22*G*, 10 *cm*. Перинеурално су апликовани бупивакаин 0,25% 30 *ml* и лидокаин 1,3% 30 *ml* без адреналина. Медијална страна надлактице је инфилтрирана лидокаином, јер је то подручје инервације интеркостобрахијалног нерва које остаје незахваћено блоком брахијалног плексуса, спречавајући бол изазван притиском турникеа. Током операције пацијенти су седирани мидазоламом. Постоперативно, пацијенти су опсервирани у Јединици интензивног лечења. Аналгезија је одржавана интравенским нестероидним антиинфламаторним лековима и трамадолом, као и блокадом брахијалног плексуса једнократно, интерскаленским приступом. Рађене су лабораторијске анализе, а свака три сата контролисани су боја и тургор коже, капиларно пуњење и тактилна температура.

Закључак Смањење периферног васкуларног отпора, спречавање вазоспазма и повећање протока крви кроз анастомозе повећавају шансу за успешну реплантацију и смањују постоперативни бол и анксиозност, што свеукупно утиче на функцију и задовољство пацијената.

Кључне речи: блокада брахијалног плексуса; микрохирургија; повреда шаке