Rev Bras Anestesiol. 2019;69(1):104-108

REVISTA BRASILEIRA DE ANESTESIOLOGIA

Publicação Oficial da Sociedade Brasileira de Anestesiologia
www.sba.com.br

CLINICAL INFORMATION

Ultrasound-guided selective nerve blocks for trigger finger surgeries to maintain flexion/extension of fingers -- Case series

Fernanda Moreira Gomes Mehlmann, Leonardo Henrique Cunha Ferraro*, Paulo César Castello Branco de Sousa, Graziella Prianti Cunha, Esthael Cristina Querido Avelar Bergamaschi, Alexandre Takeda

Universidade Federal de São Paulo (Unifesp), Escola Paulista de Medicina (EPM), Grupo de Anestesia Regional da Disciplina de Anestesiologia, Dor e Medicina Intensiva, São Paulo, SP, Brazil

Received 9 September 2017; accepted 22 June 2018
Available online 3 November 2018

KEYWORDS
Selective nerve blocks;
Ultrasound;
Flexion and extension of the fingers;
Trigger finger release

Abstract
Background: A patient's ability to move his/her fingers during hand surgery may be helpful to surgeons because it allows the effectiveness of the intervention evaluation and prediction of hand function in the postoperative period. The purpose of this case series is to demonstrate the efficacy of an ultrasound-guided peripheral nerve block technique to maintain the hand flexor and extensor muscles motor function and discuss the benefits of the technique for trigger finger surgery.
Case report: Ten patients scheduled to undergo trigger finger surgery were selected. The goal was to maintain flexion and extension of the fingers during the procedure. Thus, ultrasound-guided ulnar, radial, and medial nerve block was performed in the distal third of the forearm, at 5-7 cm proximal to the wrist. The block was performed with 5 mL of 0.375% bupivacaine on each nerve. All procedures were uneventfully performed maintaining the flexion and extension of the fingers. In two cases, it was observed that the motricity maintenance and the patients' ability to move their fingers when requested allowed the success of the surgical procedure after the third intraoperative evaluation.
Conclusion: This case series shows that it is possible to maintain the motor function of the hand flexor and extensor muscles to perform finger trigger surgeries using specific ultrasound-guided distal blocks.

* Corresponding author.
E-mail: leohcferraro1@hotmail.com (L.H. Ferraro).

https://doi.org/10.1016/j.bjane.2018.06.012

PALAVRAS-CHAVE
Bloqueios seletivos;
Ultrassom;
Flexão e extensão dos dedos;
Liberação dedo em gatilho

Bloqueios seletivos guiados por ultrassom para cirurgias de dedo em gatilho para manutenção da flexão/extensão dos dedos – Série de casos

Resumo
Justificativa: A capacidade de um paciente mover os dedos durante a cirurgia da mão pode ser útil para o cirurgião porque permite a avaliação da eficácia da intervenção e a predição da função da mão no pós-operatório. O objetivo desta série de casos é demonstrar a eficácia de uma técnica de bloqueio de nervo periférico guiado por ultrassom na manutenção da função motora dos músculos flexores e extensores da mão e discutir os benefícios da técnica para cirurgias de liberação de dedo em gatilho.
Relato de caso: Foram selecionados 10 pacientes em programação para cirurgia de liberação de dedo em gatilho. O objetivo era manter a flexão e a extensão dos dedos durante o procedimento. Dessa forma, o bloqueio dos nervos ulnar, radial e mediano, guiados por ultrassom, foi feito no terço distal do antebraço, 5 a 7 cm proximais ao punho. O bloqueio foi feito com 5 mL de bupivacaína a 0,375% em cada nervo. Todos os procedimentos foram feitos sem complicações e com manutenção da flexão e extensão dos dedos. Em dois casos, observou-se que a manutenção da motricidade e a capacidade dos pacientes de mover os dedos quando solicitado permitiu o sucesso do procedimento cirúrgico após a terceira avaliação intraoperatória.
Conclusão: Esta série de casos mostra que é possível manter a função motora dos músculos flexores e extensores da mão em cirurgias de liberação de dedo em gatilho por meio de bloqueios distais específicos guiados por ultrassom.

Introduction

Finger motion during hand surgeries can be useful for surgeons because it allows evaluating the effectiveness of the intervention and predicts the function of the hand in the postoperative period.

To achieve this goal, the technique of subcutaneous infiltration of local anesthetics with epinephrine based on anatomical landmarks has been used.[1–4] Epinephrine is used, in these cases, to decrease bleeding and to avoid the intraoperative use of tourniquet. However, depending on the extent of surgery, a large amount of local anesthetic should be used, which increases the risk of serious complications, such as systemic intoxication by these drugs.[5,6] In addition, infiltration of large volumes of local anesthetic into the surgical site may alter the anatomy and hinder the surgical procedure.

An option for subcutaneous infiltration of local anesthetic is the peripheral nerve block. Currently, with the aid of ultrasound to guide nerve blocks, it is possible to anesthetize only the terminal sensory branches and preserve the nerve motor function.[7] In addition, it is known that the use of ultrasound allows the use of smaller volumes of local anesthetic compared with blockades using anatomical landmarks and reduces the risk of systemic intoxication.[8,9]

The aim of this case series is to demonstrate the effectiveness of an ultrasound-guided peripheral nerve block technique in maintaining the motor function of the hand flexor and extensor muscles and to discuss the benefits of this technique in trigger finger surgery.

Case report

We report a case series of 10 patients who presented for surgical treatment of trigger finger on an outpatient clinic of a quaternary university hospital. After giving written informed consent, all patients received routine monitoring for a surgical procedure with cardioscopy, sphygmomanometer, and pulse oximeter, and a peripheral venous access was obtained in the limb contralateral to the procedure.

For finger trigger surgery, the maintenance of flexion and extension of the finger phalanges is necessary. Thus, a blockade involving the ulnar, radial, and medial nerve was performed in the distal third of the forearm, 5–7 cm proximal to the wrist, where the probability of these nerves presenting motor endings to the flexor and extensor muscles of the hand is lower.[10,11] At this site, the ulnar nerve is visible medially to the ulnar artery, the radial sensitive branch is visible laterally to the radial artery, and the median nerve is visible between the terminal muscle fibers of the flexor muscles: *carpi radialis, digitorum profundus, digitorum superficialis, pollicis longus, and palmaris longus* (Figs. 1 and 2).[12,13] After skin asepsis and antisepsis with chlorhexidine, puncture site analgesia was performed with 1% lidocaine (1 mL) and the ultrasound-guided peripheral nerve block with 0.375% bupivacaine (5 mL) on each nerve (S Series, Fujifilm Sonosite, Seattle, USA). In addition, at the elbow level, 3 mL of 2% lidocaine were injected around the lateral cutaneous nerve of the forearm, due to the use of pneumatic tourniquet in the middle third of the forearm.

Thermal sensation evaluation was made with gauze and alcohol, testing the sensitivity of the dermatomes

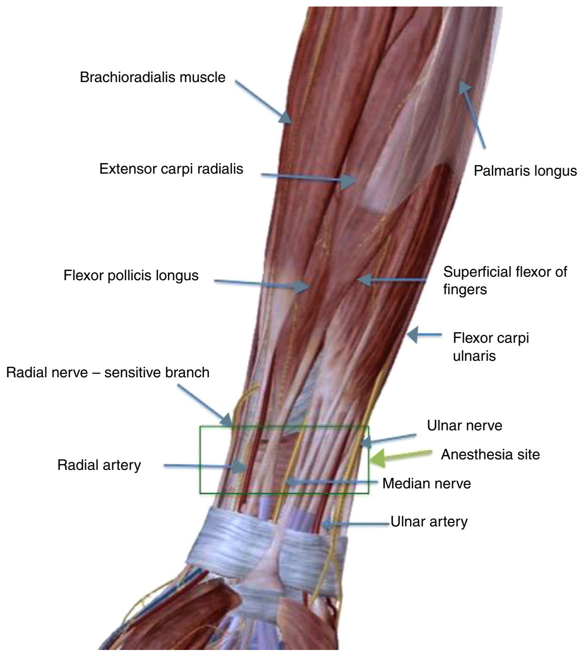

Figure 1 Relationship between the median, ulnar, and radial nerves with the flexor muscles of the hand in the anterior region of the forearm. It is observed that the proximal third of the forearm muscles, the portion that receives the motor nerve endings, is proximal to the anesthetic site, which is made in the distal part of the forearm.

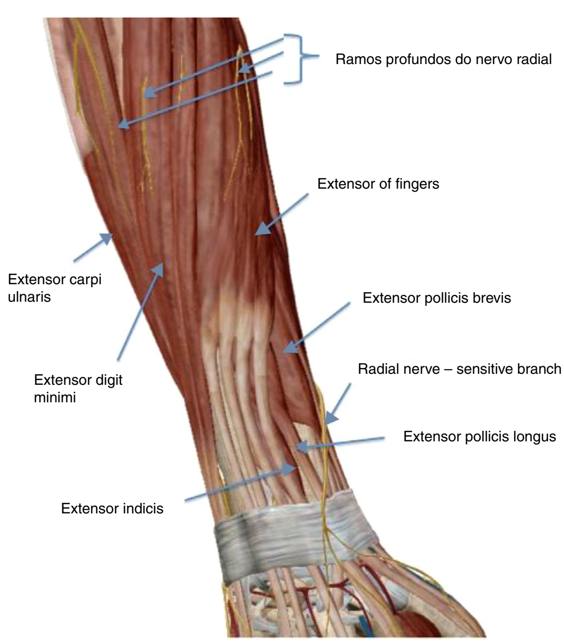

Figure 2 Relation between median, ulnar, and radial nerves with the hand extensor muscles in the forearm posterior region. It is observed that the proximal third of the forearm muscles, the portion that receives the motor nerve endings, is proximal to the anesthetic site, which is made in the distal part of the forearm.

Table 1 Modified Bromage scale.[14]

Grade	Definition
4	Complete muscle strength in relevant muscle groups
3	Reduced strength but able to move against resistance
2	Ability to move against gravity but not against resistance
1	Discrete (shaking) movements of muscle groups
0	Absence of movement

Table 2 Surgical site, blockade latency, surgical time, and tourniquet time.

Trigger finger release	*n*
Second finger	2
Third finger	6
Fourth finger	2
Latency (min)[a]	10 ± 4.8
Surgical time (min)[a]	41 ± 5.6
Tourniquet time (min)[a]	31 ± 3.15

[a] Mean and standard deviation.

innervated by the ulnar, median, and radial nerves in the hand. In addition, for motor function evaluation, the modified Bromage scale[14] (Table 1) was used for the flexors and extensors of the fingers.

The loss of thermal sensitivity of the areas corresponding to the blocked nerves without change in motor force was considered the criterion for proceeding to surgery. During the procedure, patients received mild sedation with 1–2 mg of intravenous midazolam for comfort, which did not interfere with patient communication so that he could move his hand when requested. For all procedures, a tourniquet was used at the forearm level.

All procedures were uneventful, with maintenance of flexion and extension of the fingers, which allowed the surgical procedure evaluation throughout the intraoperative period (Table 2), facilitating the evaluation of the result of the surgery throughout the procedure. This was particularly important in two cases in which the maintenance of motor function and patient collaboration when moving the operated finger as requested enabled the success of the surgical procedure after the third intraoperative evaluation, which would not have been possible if the patient had no active motion. Only one case had finger extension paralysis at the end of the procedure, which was solved after tourniquet release.

After surgery, the patients were admitted to the Post-Anesthesia Care Unit (PACU) and remained monitored until they reached outpatient discharge conditions. While in the PACU, the patient postoperative analgesia was assessed using a numerical pain scale (0 = no pain and 10 = worst possible pain) and by total analgesic consumption on demand. All patients did not report pain in PACU. All patients were discharged on the same day of surgery, without the need for hospital readmission.

Discussion

Maintaining the motor function of fingers can help to evaluate the intraoperative surgical outcome during some surgical procedures, especially for tenorrhaphy surgery, tenolysis, and trigger finger release. For such, it is fundamental to understand the anatomy of motor nerve primary branches and terminal nerve entry points to muscles of forearm.

In proximal forearm, the median nerve sends out branches to the pronator, flexor carpi radialis, long palmar, and superficial flexor muscles of the fingers. The anterior interosseous nerve, an exclusively motor branch of the median nerve, innervates the deep flexor muscles for the II and III fingers, flexor pollicis longus, and pronator quadratus. In distal forearm, approximately 5 cm proximal to the wrist, the median nerve emits its first sensory branch known as the palmar cutaneous nerve that passes externally to the carpal tunnel to innervate the thenar eminence on the palmar surface of the hand. In addition to this branch, the median nerve also emits terminal sensorial digital branches to the palmar surface of the thumb, forefinger, middle finger, and lateral half of the annular finger and innervates the dorsal portion of the distal phalanges of the index and annular fingers.

The ulnar nerve, after passing through the elbow ulnar sulcus, follows the path toward the hand and passes under the cubital tunnel (humeral ulnar aponeurotic arcade) formed by the tendon arch that connects the humerus with the head of the flexor carpi ulnaris muscle. In the cubital tunnel, the ulnar nerve sends motor branches to the flexor carpi ulnaris muscle and deep flexor of the IV and V fingers. Approximately 5 cm proximal to the wrist, the ulnar nerve emits a sensory branch known as dorsal ulnar cutaneous branch, responsible for the sensitivity of the medial and dorsal region of the hand, medial portion of the annular finger and little finger. Just before entering the wrist, near the styloid process of the ulna, the ulnar nerve emits another sensory branch called the palmar cutaneous nerve, which supplies the cutaneous sensitivity of the hypothenar eminence. The ulnar nerve finally enters the wrist through the Guyon's canal, where it divides into terminal motor and sensory branches. The sensory terminal branch leaves the ulnar nerve inside the Guyon's canal to supply cutaneous sensibility to the palmar surface of the V finger and medial half of the IV finger. The motor terminal branch innervates the dorsal and palmar interosseous muscles, III and IV lumbrus, and adductor muscle of the thumb.

The radial nerve, before crossing the humerus posteriorly, through the spiral or radial groove, emits three sensory branches: the posterior cutaneous nerve of the arm, the lateral cutaneous nerve of the lower arm, and the posterior cutaneous nerve of the forearm. Only then does it crosses from medial to lateral before entering the anterior arm compartment through the lateral intermuscular septum. In its descending path through the anterolateral portion of the arm, the radial nerve sends branches to the brachioradialis and extensor carpi radialis longus muscles before entering the radial tunnel near the lateral epicondyle of the humerus. The radial tunnel is formed by the humerus posteriorly, brachial muscle medially, and brachioradialis and extensor carpi radialis muscles anterolaterally. Within the radial tunnel, the radial nerve divides into two terminal branches: posterior interosseous nerve, an exclusively motor branch, and superficial radial nerve, an exclusively sensory branch.

Anatomical studies on corpses have shown that the proximal third of the forearm muscles is, in most cases, the muscular portion that receives the motor nerve endings. Thus, the closer to the wrist, the lower the likelihood of these nerves having motor endings for the flexor and extensor muscles of the hand. Therefore, a distal anesthetic block would provide a sensory anesthesia of the hand without loss of motor function of major muscle groups responsible for finger flexion and extension. In this case series, we demonstrated that all patients maintained the flexion and extension of their fingers after the distal blockade of these nerves.

Posteriorly in this case series, it was possible to evaluate the impact of using a tourniquet on finger motricity. It was observed that, despite using a tourniquet on average for 30 minutes, in only one case the loss of the radial motor function was observed, which was recovered after releasing the tourniquet.

Finally, with this technique, it was possible to use smaller volumes of local anesthetic, compared with the anatomical landmarks technique, and increase the safety of procedures.

This case series has some limitations. First, we consider for motility only the flexion and extension of the fingers; for example, we do not evaluate adduction, abduction, pinching and thumb opposition, the latter may be compromised by a possible blockade of thenar muscles. In addition, we opted for the application only in trigger finger release surgeries. Further studies are needed to evaluate the efficacy of this technique for other hand surgeries, such as tenolysis and tenorrhaphy.

In conclusion, this case series shows that it is possible to perform specific blocks in finger trigger surgeries and maintain the hand flexor and extensor muscles motricity, which allows the control of the motor function of the procedure by the surgical team.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Lalonde DH. Wide-awake flexor tendon repair. Plast Reconstr Surg. 2009;123:623–5.
2. Nelson R, Higgins A, Conrad J, et al. The wide-awake approach to Dupuytren's disease: fasciectomy under local anesthetic with epinephrine. Hand (N Y). 2010;5:117–24.
3. Tang JB. Wide-awake primary flexor tendon repair, tenolysis, and tendom transfer. Clin Orthop Surg. 2015;7:275–81.
4. Lalonde DH, Wong A. Dosage of local anesthesia in wide awake hand surgery. J Hand Surg Am. 2013;38:2025–8.
5. Hutting K, van Rappard JR, Prins A, et al. Digital necrosis after local anaesthesia with epinephrine. Ned Tijdschr Geneeskd. 2015;159:9477.
6. Prabhakar H, Rath S, Kalaivani M, et al. Adrenaline with lidocaine for digital nerve blocks. Cochrane Database Syst Rev. 2015;19:CD010645.

7. Nakanishi Y, Omokawa S, Kobata Y, et al. Ultrasound-guided selective sensory nerve block for wide-awake forearm tendon reconstruction. Plast Reconstr Surg Glob Open. 2015;5:e392.
8. McNaught A, Shastri U, Carmichael N, et al. Ultrasound reduces the minimum effective local anaesthetic volume compared with peripheral nerve stimulation for interscalene block. Br J Anaesth. 2011;106:124–30.
9. Barrington MJ, Kluger R. Ultrasound guidance reduces the risk of local anesthetic systemic toxicity following peripheral nerve blockade. Reg Anesth Pain Med. 2013;38:289–99.
10. Liu J, Pho RW, Pereira BP, et al. Distribution of primary motor nerve branches and terminal nerve entry points to the forearm muscles. Anat Rec. 1997;248:456–63.
11. Safwat MD, Abdel-Meguid EM. Distribution of terminal nerve entry points to the flexor and extensor groups of forearm muscles: an anatomical study. Folia Morphol (Warsz). 2007;66:83–93.
12. Jon C, Thompson:. Netter's concise orthopaedic anatomy. In: Updated edition. 2nd ed. Philadelphia, PA: Saunders/Elsevier; 2015.
13. Matloub HS, Yousif NJ. Peripheral nerve anatomy and innervation pattern. Hand Clin. 1992;8:201–14.
14. Ferraro LH, Takeda A, dos Reis Falcão LF, et al. Determinação do volume mínimo efetivo de bupivacaína 0,5% para bloqueio do plexo braquial por via axilar guiado por ultrassom. Rev Bras Anestesiol. 2014;64:49–53.