Regional Anesthesia and Pain

Blocks at the wrist provide effective anesthesia for carpal tunnel release

[Les blocs au poignet procurent une anesthésie efficace pour la chirurgie de décompression du canal carpien]

Laurent Delaunay MD,* Jacques E. Chelly MD PhD MBA†

Purpose: Distal blocks are not recommended even for a short procedure when a tourniquet is used. This study was designed to evaluate the tolerance, effectiveness, patient acceptance and safety of distal blocks at the wrist.

Methods: Consecutive patients ($n=273$, mean age 53 ± 15 yr) undergoing endoscopic carpal tunnel release with a pneumatic tourniquet were included in this study. The median nerve was blocked 6 cm above the wrist crease by injecting 10 mL of 2% lidocaine and 0.5% bupivacaine (v/v). The ulnar nerve was blocked by injecting 8 mL of the same anesthetic mixture below the flexor carpi ulnaris tendon 6 cm above the wrist crease. Finally, 2 mL of local anesthetic were infiltrated sc and laterally below the crease to block the musculocutaneous nerve. The intensity of the block was evaluated after five, ten and 20 min. In addition, pain associated with block performance and tolerance of the tourniquet were evaluated. Finally, neurological complications associated with this technique were investigated. Data are presented as means $\pm$ SD.

Results: At ten minutes after the block was performed, 9% and 32% of patients required an additional injection to complete the block in the median and ulnar territories, respectively. In more than 75% of patients, performance of the block was associated with either no or mild pain. The tourniquet was inflated for 12.6 ± 5.4 min and was well tolerated in 99% of patients. Finally, neither transient nor permanent neurological deficit were recorded postoperatively.

Conclusion: Blocks at the wrist are effective, well accepted by the patient and safe when a pneumatic tourniquet is used for a short procedure.

Objectif: Les blocs distaux ne sont pas recommandés, même pour des interventions de courte durée, quand un garrot pneumatique est utilisé. Le but de cette étude était d'évaluer la tolérance, l'efficacité et la sécurité des blocs tronculaires au poignet.

Méthodes: Deux cent soixante-treize malades consécutifs, âgés de 53 ± 15 ans opérés d'un syndrome du canal carpien ont été inclus dans cette étude. Le nerf médian était bloqué 6 cm au-dessus du pli de flexion du poignet avec 10 mL d'un mélange de lidocaïne 2 % et de bupivacaine 0,5 % (50/50). Le nerf ulnaire était bloqué avec 8 mL du même mélange en-dessous du tendon fléchisseur ulnaire du carpe 6 cm au-dessus du pli de flexion du poignet. Enfin, 2 mL d'anesthésiques locaux étaient injectés latéralement et immédiatement en-dessous du pli de flexion pour bloquer le nerf musculocutané. L'intensité du bloc a été évaluée à cinq, dix et 20 min. La douleur lors de la réalisation du bloc et la tolérance du garrot étaient également évaluées. Enfin, les complications neurologiques associées à ces techniques ont été recherchées. Les résultats sont présentés en moyenne $\pm$ SD.

Résultats: Après dix minutes, 9 % et 32 % des patients ont nécessité un complément d'anesthésie au niveau des nerfs médian et ulnaire. Chez plus de 75 % des malades, la réalisation du bloc était associée à une douleur qui était, soit absente, soit modérée. Le garrot était gonflé en moyenne $12,6 \pm 5,4$ min et considéré comme supportable par 99 % des malades. Aucun déficit neurologique partiel ou total n'a été constaté en postopératoire.

Conclusion: Pour des interventions de courte durée, les blocs au poignet sont efficaces, sans risque et bien acceptés par le patient même quand un garrot pneumatique est utilisé.

It is well established that most surgeries at the wrist are

From the Département d'anesthésiologie,* Clinique Générale, Annecy, France, and the Department of Anesthesiology,† The University of Texas Houston Health Science Center, Houston, Texas, USA.

Address correspondence to: Dr. Jacques E. Chelly, The University of Texas Health Science Center at Houston, Department of Anesthesiology, 6431 Fannin, MSB 5.020, Houston, Texas 77030-1503, USA. Phone: 713-500-6182; Fax: 713-500-6201; E-mail: Jacques.E.Chelly@uth.tmc.edu

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performed using a tourniquet to minimize blood loss. Although general anesthesia is still often used for patients undergoing distal upper extremity surgeries, local infiltration either alone¹⁻³ or combined with sedation,⁴ *iv* regional anesthesia,⁵ brachial plexus blocks,⁶⁻⁸ and distal blocks at the wrist⁹ also seem to be indicated. For limited procedures such as endoscopic carpal tunnel release, which are mostly performed on an outpatient basis and sometimes even as an office procedure, it seems that distal blocks at the wrist should be especially appropriate. These blocks are easy and quick to perform, provide the limited and surgically required sensory block in the absence of significant motor block, and provide good postoperative analgesia. However, these blocks have the reputation of being of limited interest because they do not prevent tourniquet pain and are claimed to be associated with an increased risk of postoperative neurological complications.¹⁰ Historically, they have mostly been used to complement incomplete brachial plexus blocks.¹⁰

This study was designed to assess the safety, effectiveness and tolerability of distal median, ulnar and musculocutaneous blocks at the wrist in patients undergoing minor outpatient surgery in the absence of sedation.

Methods

The study protocol was approved by the Committee for Human Protection of The University of Texas. Patient consent was obtained preoperatively. Two hundred seventy-three consecutive patients undergoing carpal tunnel release were enrolled in this study. Medical history and physical examination, including neurological examination, as well as laboratory and EKG testing were obtained preoperatively. After placement of a peripheral *iv* line and standard monitors (pulse oximetry, non-invasive blood pressure and DII EKG lead), median, ulnar and musculocutaneous blocks at the wrist were performed with a mixture of 2% lidocaine and 0.5% bupivacaine (v/v), using a 25-g 16-mm needle.

The anatomical landmarks for the median, ulnar and musculocutaneous nerves at the wrist are presented in Figure 1. The median nerve passes between the flexor carpi radialis tendon and the palmaris longus tendon. Therefore, the median nerve block was performed by injecting 10 mL of the local anesthetic mixture medially to the flexor carpi radialis tendon at a depth of 16 mm and at 6 cm above the wrist crease. The ulnar nerve passes under the flexor carpi ulnaris tendon and medial to the ulnar artery. Therefore, the ulnar nerve block was performed by injecting 8 mL of the local anesthetic mixture under the flexor carpi

FIGURE 1 The anatomical landmarks for the median, ulnar and musculocutaneous nerves at the wrist.

FIGURE 2 Site of the introduction of the needle to block the median nerve (medial to the flexor carpi radialis tendon), the ulnar nerve (inferior to the flexor carpi ulnaris tendon) and musculocutaneous nerve (lateral and above the wrist crease).

ulnaris tendon at a depth of 9–10 mm and at 6 cm above the wrist crease. Finally, the musculocutaneous nerve branches were blocked by a subcutaneous and lateral injection of 1–2 mL of local anesthetic mixture just above the wrist crease (Figure 2).

Patients were asked to grade paresthesia during performance of blocks using a three-level scale: 0=no paresthesia; 1=mild paresthesia (feeling of minor stimulations without withdrawal movement); and 2=moderate paresthesia (moderate electrical discharges associated with withdrawal movement). In addition, a four-level scale was used to determine the level of pain at the end of the performance of the blocks: 0=no pain; 1=mild pain; 2=moderate pain; and 3=severe pain. The patients were also asked to evaluate the pain associated with tourniquet inflation using a ten-level scale (ranging from 0=no pain to 10=maximum pain) and tourniquet pain during surgery using a four-level scale.

The intensity of the sensory block was evaluated with ice at five, ten and 20 min in each nerve territory using a three-level scale: 0=cold; 1=cold attenuated; and 2=no cold with or without touch sensation. The intensity of the ulnar sensory block was tested at the medial aspect of the hand and little finger, and the lateral part of the palm at the level of the index finger and the lateral part of the wrist were used to test the intensity of the median and musculocutaneous blocks. If the score was 0 or 1 at ten minutes, an additional 5 mL of the mixture was injected to complete the block in that territory.

The patient was considered ready for surgery when a score of 2 was obtained in each territory. A tourniquet was then placed on the forearm and inflated at 300 mmHg. If tourniquet pain occurred at some distance from the inflation, *iv* propofol in 20-mg increments was administered. Finally, the surgeon was provided with 1% lidocaine to complement the analgesia as required during surgery. Neurological examination was performed by an independent observer (surgeon) prior to, the day after and one week after the surgery to assess for new transient or permanent nerve damage.

Data are presented as mean $\pm$ SD or percentage as appropriate.

Results

The patient characteristics of the 273 patients enrolled in this study include mean age 53 ± 15 yr, sex ratio 68 males/205 females, and ASA I to III. Since three nerves were blocked in each patient, a total of 819 blocks at the wrist were performed. After the initial administration of local anesthetics, additional injections were required to complete the blocks at ten minutes in 9% of blocks in the median territory, 32% of blocks in the ulnar territory and 0% of blocks in the musculocutaneous territory. However, a score of 2 (ready for surgery) at 20 min was recorded in all patients.

As indicated in Figure 3, no patient experienced severe pain during performance of the blocks. Although 93% of patients did not complain of any paresthesia during performance of the blocks, mild paresthesia was reported in 5% of patients and moderate paresthesia was observed in 2%.

The tourniquet was inflated for 12.6 ± 5.4 min. The pain score attributable to tourniquet inflation during surgery was 2.6 ± 1.9 . Inflation of the tourniquet was well tolerated in all but four patients who complained of severe pain. In three of these four patients, the reduction of tourniquet pressure effectively eliminated the pain; one patient required *iv*

FIGURE 3 Percentage of patients experiencing no, mild, moderate and severe pain during the performance of the blocks and inflation of the tourniquet.

sedation with 30 mg of propofol.

During surgery, 85% of patients felt nothing or only touch and 15% experienced mild pain, but no patient required any additional local anesthetic injection by the surgeon.

Postoperative neurological evaluation by the patient's surgeon indicated that no patient reported new sensory or motor nerve complications related to the blocks.

Discussion

For endoscopic carpal tunnel release surgery, the technique described satisfied surgical requirements without the need for additional sedation or injection of local anesthetics by the surgeon. Furthermore, our data do not support the concept that performing blocks at the wrist increases risk for nerve damage, but rather indicate that this technique is safe. The risk of transient or permanent nerve damage following blocks at the wrist does not appear to be higher than that recorded after brachial plexus blocks, which is estimated to vary from 2.1¹¹ to 9%.¹² This seems to be higher than the estimated risk observed in our series.

Multiple injections at the same site have been also claimed to increase the risk for nerve damage following nerve blocks. Horlocker *et al.*¹³ reported that the risk of neurologic complications is not increased in patients who undergo multiple axillary blocks, even within a one-week interval. In our study, a total of 113 blocks (14%) required a second injection of local anesthetics to complete the blocks in the median and ulnar territories. Since no neurological deficit was attributed postoperatively to the performance of any of these blocks, our

data suggest that a second immediate injection to complete a block also does not represent an increased risk for postoperative neurological complications.

Although some surgeons advocate only the use of local infiltration for carpal tunnel release,¹⁴ surgeons in our institution perform this surgery using an upper arm tourniquet. It is established that tourniquet pain is of two types:^{15,16} the first occurs immediately after cuff inflation and is mostly pressure dependent; the second generally occurs after 30 min of tourniquet time and is pressure independent. In our study, the inflation time of the tourniquet was less than 15 min, similar to the times reported by Wilson *et al.*¹⁵ Our data confirm that for short hand procedures the tourniquet is well tolerated, as in normal volunteers,^{16,17} and therefore does not require any particular attention. These are important considerations in favour of the use of distal blocks at the wrist for this type of surgery. The tourniquet pain observed in our study was of the first type, as indicated by its relief after partial deflation of the tourniquet. Only one patient required 30 mg propofol for the treatment of tourniquet pain.

Anatomical considerations dictated the choice of performing the medial and ulnar blocks 6 cm above the wrist to assure that all sensory branches of the median and ulnar nerves were included; these nerves provide palmar branches that originate above the wrist.¹⁸ Blocking the median and ulnar nerves at the level of the wrist would increase the risk of producing an incomplete block by missing the palmar branches. Although there are alternative techniques that provide analgesia for carpal tunnel release surgery, most of them appear disproportionate to the surgical requirements. IV regional anesthesia is a popular technique that continues to be used. However, endoscopic carpal tunnel surgery requires only a few minutes of anesthesia, as indicated by our short tourniquet inflation times. The use of a Bier block is better indicated for surgery requiring between 30 and 45 min. Early deflation of the tourniquet has been associated with seizures or cardiac arrhythmias related to systemic local anesthetic toxicity.^{5,19}

As indicated by the percentage of blocks requiring a second injection at ten minutes, it seems that the technique described was adequate to produce median and musculocutaneous blocks. However, we encountered a high degree of failure following ulnar injection, with 31% of patients requiring a second injection to produce a complete ulnar block; this result indicates that the ulnar block technique was not optimum. To improve our results, we have started to use a nerve stimulator to locate the ulnar nerve. Our preliminary data suggest

that the use of neurostimulation to locate the ulnar nerve is associated with a higher success rate and that the ulnar nerve is more superficial than originally estimated.

In conclusion, our study suggests that distal blocks at the wrist are safe and well tolerated. The described technique is simple, easy to perform, and clearly satisfies both patient and surgical requirements for carpal tunnel release surgery. However, the technique described to block the ulnar nerve was associated with a low success rate. This suggests that consideration should be given to the use of nerve stimulation to improve results. Finally, this study indicates that the tourniquet is well tolerated and does not require any special consideration when inflated for less than 15 min.

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