

# Dosage of Local Anesthesia in Wide Awake Hand Surgery

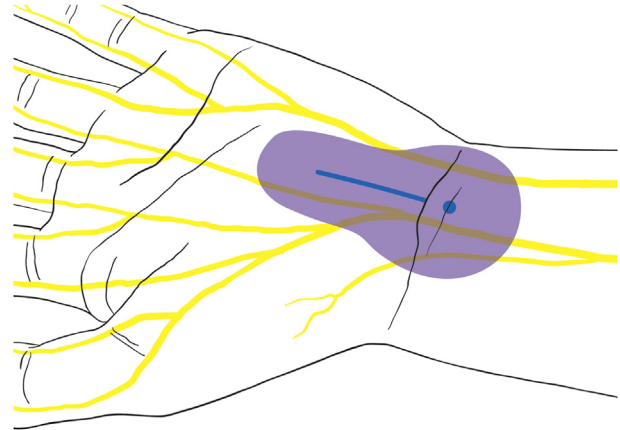
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ONE OF THE MORE NOTABLE recent changes in hand surgery is the method of delivery of the anesthesia. Similar to when they are having a dental procedure, patients who understand and are offered the wide awake alternative like the ideas of (1) no preoperative testing, (2) no tourniquet pain, (3) less time at the hospital to have the surgery, (4) the ability to speak to their surgeon during the surgery, and (5) no sedation to cloud their head when they get home from their surgery.<sup>1</sup>

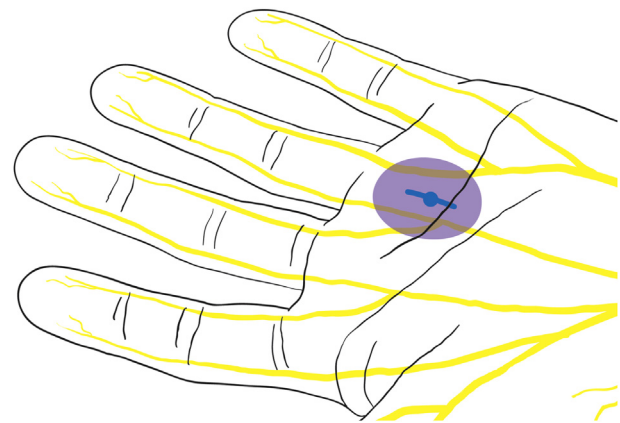
## THE PRINCIPLE OF MINIMAL PAIN INJECTION TUMESCENT LOCAL ANESTHESIA

Tumescent local anesthesia is like a tourniquet-free extravascular Bier block in which lidocaine with epinephrine is injected subcutaneously only where it is needed; everywhere the surgeon will be dissecting, moving fractures, or inserting K-wires (see Figs. 1–5, Table 1). Epinephrine is used for hemostasis instead of the tourniquet. Epinephrine safety in the finger is well established.<sup>2</sup>

A 27-gauge needle hurts less going in the skin than a 25-gauge needle and helps remind the injector to slow down. Begin by injecting 2 cc slowly, just below the skin. Small subcutaneous veins can be avoided at the needle penetration site by first visualizing them and then collapsing them with antegrade injection. Small amounts of inadvertent intravascular injection of lidocaine with epinephrine are well tolerated.



**FIGURE 1:** Carpal tunnel. Insert 10 cc in the subcutaneous fat without moving the needle at the blue dot. Eliciting paresthesias should be avoided; it may mean fascicle laceration by the sharp needle bevel. Insert a second 10 cc under the incision in the subcutaneous fat.



**FIGURE 2:** Trigger finger. Insert 4 cc in the subcutaneous fat without moving the needle at the blue dot. No need to inject in the sheath.

Always ensure that there is 1 cc visible or palpable local anesthesia ahead of the sharp needle tip to avoid injection pain. For large areas, reinsertion of the needle is performed within 1 cm of visible palpable local anesthesia to avoid the pain of reinsertion.

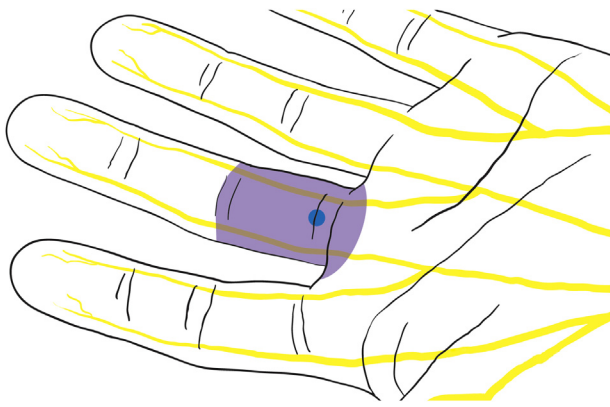
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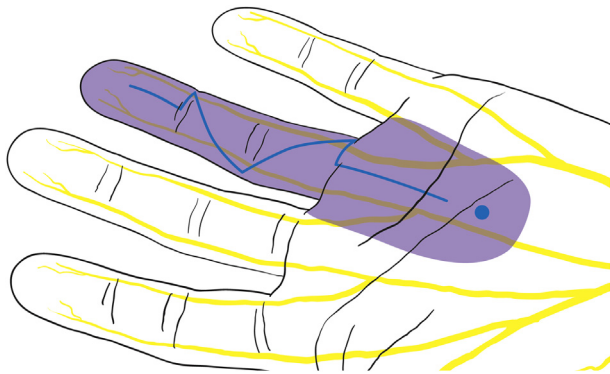
No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

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**FIGURE 3:** Single Subcutaneous Injection in the Middle of the Proximal Phalanx with Lidocaine and Epinephrine (SIMPLE) block. Insert 2 cc for sensory finger block and vasoconstriction in the area where the local is injected.



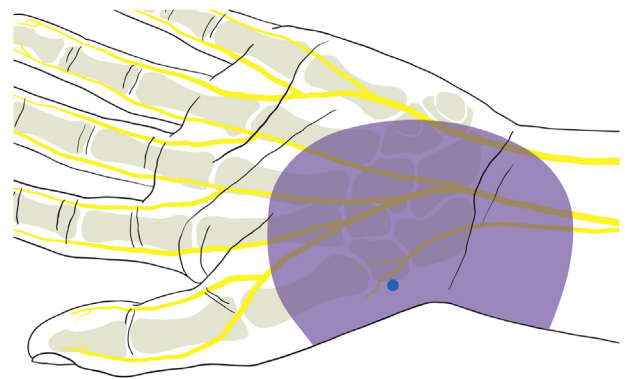
**FIGURE 4:** Zone 2 flexor tendon or Dupuytren palmar fasciectomy. Insert 15 cc or more per ray. Start with 10 cc in the palm, 1 cm proximal to the most proximal place you are likely to make an incision. Add 2 cc per proximal and middle phalanx and 1 cc in the distal phalanx base volar-midline subdermal fat.

Inject slowly to decrease pain. The mantra is: “Blow slow before you go.” The surgeon can learn from each patient by asking him or her to score the number of times pain is felt during the injection.

At the end of the injection, there should be at least 1 cm of adrenalized skin (pale with palpable local anesthesia) beyond all borders of incision and dissection sites.

#### DOSAGE OF LIDOCAINE WITH EPINEPHRINE

Although some literature supports the safe use of 35 mg/kg lidocaine with epinephrine,<sup>3</sup> the generally accepted maximal dose is 7 mg/kg (Table 1). The average 70-kg person can, therefore, safely receive 50 cc 1% lidocaine with epinephrine. This mixture remains quite effective if it is diluted with up to 150 cc saline to the frequently used 1/4% lidocaine with



**FIGURE 5:** Trapeziectomy or Bennett fracture. Insert 40 cc all around the trapezium, metacarpal base, and surrounding bones and joints where dissection or K-wires are likely to generate pain.

1:400,000 epinephrine. Be generous with the volume so that “top-ups” are never required.

If 50 cc or less volume is needed, use 1% lidocaine with 1:100,000 epinephrine. If 50–100 cc volume is required, use 1/2% lidocaine with 1:200,000 epinephrine. For 100–200 cc volume, use 1/4% lidocaine with 1:400,000 epinephrine.

Many published concentrations of bicarbonate are used to neutralize the acidic average pH of 4.7 of 1% lidocaine with 1:100,000 epinephrine, but the preferred ratio is 10 cc lidocaine to 1 cc 8.4% bicarbonate to decrease injection pain.<sup>4</sup>

#### LIDOCAINE VERSUS BUPIVACAINE FOR LOCAL ANESTHESIA

Bupivacaine is widely used because of its longer duration of action. The authors prefer lidocaine to bupivacaine as their principal agent of local anesthesia for 3 reasons. First, intravascular bupivacaine can be cardiotoxic and cause mortality, whereas intravenous lidocaine has a proven safety record as an antiarrhythmic agent. Second, lidocaine and epinephrine have an excellent track record with more than 60 years of millions of doses in dental offices with no patient monitoring.<sup>6</sup> Third, the pain-relieving effect of bupivacaine can last half as long as its more annoying touch and pressure numbness. This is why patients complain of pain even though their hand is still numb after bupivacaine injection.<sup>7</sup>

The authors add 10 cc 0.5% bupivacaine with 1:200,000 epinephrine to the total injectate in cases anticipated to last more than 2.5 hours in case the pain effect of lidocaine begins to wear off.

**TABLE 1. Typical Volumes Used for Common Operations**

Operation	Typical Volume of 1% Lidocaine With 1:100,000 Epinephrine and 8.4% Bicarbonate (Mixed 10mL:1mL)	Location of Injection
Carpal tunnel (Fig. 1)	20 cc	10 cc between ulnar and median nerves (5 mm proximal to wrist crease and 5 mm ulnar to median nerve); another 10 cc under incision
Trigger finger (Fig. 2)	4 cc	Subcutaneously beneath the center of the incision
Finger sensory block (SIMPLE) <sup>5</sup> (Fig. 3)	2 cc	Volar middle of proximal phalanx just past palmar-finger crease
Finger soft tissue lesions or other surgery when finger base tourniquet is not desirable and finger epinephrine is used for hemostasis	5 cc volar distributed among 3 phalanges, 4 cc dorsal split between 2 phalanges	2 cc volar and 2 cc dorsal subcutaneous midline fat, in both proximal and middle phalanges. The distal phalanx gets only 1 cc midline volar, just past the DIP crease
PIP arthrodesis	8 cc total, 4 cc volar (2 in each phalanx) and 4 cc dorsal (2 in each phalanx)	2 cc midvolar and another 2 cc middorsal of both proximal and middle phalanges
Thumb MCP arthrodesis and collateral ligament tears of the MCP joint	15 cc	2 cc on each of volar and dorsal aspects of proximal phalanx and the rest all around the metacarpal head
Dupuytren contracture or zone II flexor tendon repair (Fig. 4)	15 cc/ray	10 cc (or more) in the palm, then 2 cc in the proximal and middle phalanges and 1 cc in the distal phalanx (if required)
Trapeziectomy or Bennet fracture (Fig. 5)	40 cc	Radial side of the hand under the skin and all around the joint, including the median nerve. If LRTI is performed, decrease concentration to 0.5% lidocaine with 1:200,000 epinephrine, and also inject all around where FCR or APL will be dissected
Metacarpal fractures	40 cc	All around the metacarpal where dissection or K-wires will occur

SIMPLE, single subcutaneous injection in the middle of the proximal phalanx with lidocaine and epinephrine; DIP, distal interphalangeal joint; PIP, proximal interphalangeal joint; MCP, metacarpophalangeal joint; LRTI, ligament reconstruction and tendon interposition; FCR, flexor carpi radialis; APL, abductor pollicis longus.

### WHERE AND WHEN TO INJECT LOCAL ANESTHESIA FOR HAND SURGERY

The authors recommend injecting patients on a stretcher outside the operating room for 3 reasons. First, this gives the epinephrine more time to reach the maximal optimal vasoconstriction time of 26 minutes.<sup>8</sup> Second, the most common adverse reaction of local anesthesia injection is a vasovagal reaction that generates fainting because of decreased cerebral blood flow. This occurs more frequently when patients sit up to be injected. Third, the injection of the local anesthesia itself does not waste valuable operating room time if it is performed outside the operating room.

### LARGE-VOLUME SPAGHETTI WRIST AND FOREARM TENDON TRANSFERS (50–200 cc)

In *spaghetti wrist* and ulnar nerve decompression at the elbow, 50 to 100 cc 0.5% lidocaine with 1:200,000 epinephrine is injected from proximal to distal wherever dissection is anticipated. For forearm tendon transfers, up to 200 cc 1/4% lidocaine with 1:400,000 epinephrine is used. Because these cases can take more than 2.5 hours, bupivacaine is added to the entire injectate, as described earlier.

Sensory nerves need to be bathed in local anesthesia when working in the wrist or forearm. However, it is preferable to leave the forearm motor nerves intact to observe active movement of repaired

or transferred structures by the clear-headed, pain-free patient before the skin is closed.

In conclusion, the goal of tourniquet-free local anesthesia injection is to get lidocaine and epinephrine molecules wherever the surgeon will dissect, move fractures, or insert K-wires. Local anesthesia can be injected over large areas in a relatively pain-free manner in an antegrade fashion if injected slowly. Avoiding the tourniquet can improve patient convenience and satisfaction.

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