

Digital Necrosis After Lidocaine and Epinephrine Injection in the Flexor Tendon Sheath Without Phentolamine Rescue

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The literature generally supports the safety of epinephrine injection in the digits, but recent case reports describe ischemic adverse events associated with the use of lidocaine and epinephrine in which phentolamine rescue was not performed. We present a case of finger necrosis and subsequent amputation in a patient after 1% lidocaine with 1:100,000 epinephrine was injected in the fat and flexor sheaths in the palm for a 3-finger trigger release. Phentolamine rescue was not performed. All surgeons who use epinephrine in the finger should be prepared to reverse vasoconstriction with phentolamine rescue if there is persistently inadequate perfusion of the fingertip. (*J Hand Surg Am.* 2017;42(2):e119–e123. Copyright © 2017 by the American Society for Surgery of the Hand. All rights reserved.)

Key words Epinephrine, finger necrosis, local anesthetic, phentolamine rescue, sheath injection.



LOCAL ANESTHETICS WITH EPINEPHRINE are now routinely used in finger surgery,¹ despite earlier teaching stating that “one should never use lidocaine with epinephrine in the fingers, ears, nose or penis.”² This was based on the belief that epinephrine would cause irreversible vasoconstriction and vascular insufficiency to the distal tissues.

A review by Denkler in 2001³ found 48 documented cases of digital necrosis from local anesthesia, none involving lidocaine with epinephrine.

Twenty-one of the case reports described digital infarction with the use of procaine or cocaine with epinephrine. Twenty-seven of the cases were with procaine or cocaine without epinephrine. Most of these cases occurred before 1950. Thomson et al⁴ concluded that most of the reported adverse events were attributable to procaine becoming acidic prior to use in an era before expiration dates for local anesthetics were established and that no rescue agent was available until phentolamine became available in 1957.

The popularity of local anesthesia with epinephrine has increased owing to the many advantages of obtaining a bloodless field without a tourniquet.^{4,5} Many studies have now demonstrated the safety of epinephrine in local anesthesia in the hand and fingers. In a prospective study of 3,110 cases, performed by 9 hand surgeons in 6 centers, none of the patients required phentolamine rescue, and no tissue loss occurred.⁵ A similar study of 1,111 finger cases had the same findings.⁶ Krunick et al,⁷ in 2004, reviewed the literature and found no cases of lidocaine-epinephrine-induced finger necrosis. In a review of accidental high-dose (1:1000) epinephrine finger

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FIGURE 1: Bullous blisters seen on postoperative day 1 from trigger finger release, early in the morning. Phentolamine was not used at this point. These were noted at the index, middle, and ring fingertips.



FIGURE 2: Following the uneventful release of trigger finger with the patient under lidocaine with epinephrine, finger necrosis occurred at the index, middle, and ring fingertips. There was progressive demarcation of ischemic necrosis of these fingertips.

injections, mostly from anaphylactic autoinjectors (EpiPen), there were no cases of finger necrosis documented, in spite of the fact that only 13 of the 59 patients had their epinephrine vasoconstriction reversed with phentolamine rescue.⁸

More recently, 3 case reports have documented adverse effects associated with lidocaine and epinephrine in digital blocks. Phentolamine rescue was not used in any of these cases. This paper presents a fourth such case and illustrates with video how to rescue the white fingertip with phentolamine in finger flexor tendon sheaths injected with lidocaine and epinephrine.

CASE REPORT

A 63-year-old woman presented with triggering of her left index, middle, and ring fingers unresponsive to steroid injections. She had previously undergone successful release of the flexor tendon sheath in her left thumb and little finger for triggering using lidocaine and epinephrine local anesthesia without adverse outcome. She had a 40-pack-year smoking history and continued to smoke 1 pack of cigarettes daily. She had no other known vascular pathology such as Raynaud or Buerger disease.

The procedure was carried out with 2 to 3 mL of 1% lidocaine (Xylocaine) with 1:100,000 epinephrine injected into each of the second, third, and fourth flexor sheaths and subcutaneous fat between the distal palmar crease and the palmar-digital crease of



FIGURE 3: Two weeks following the initial procedure, the patient underwent amputation of the gangrenous index and middle fingertips while the ring fingertip was left to heal secondarily. The revision amputation wounds were left to heal secondarily.

the hand. The surgery was uneventful. The fingertips were pale on discharge.

The patient presented to the emergency room the following morning complaining of severe pain to the

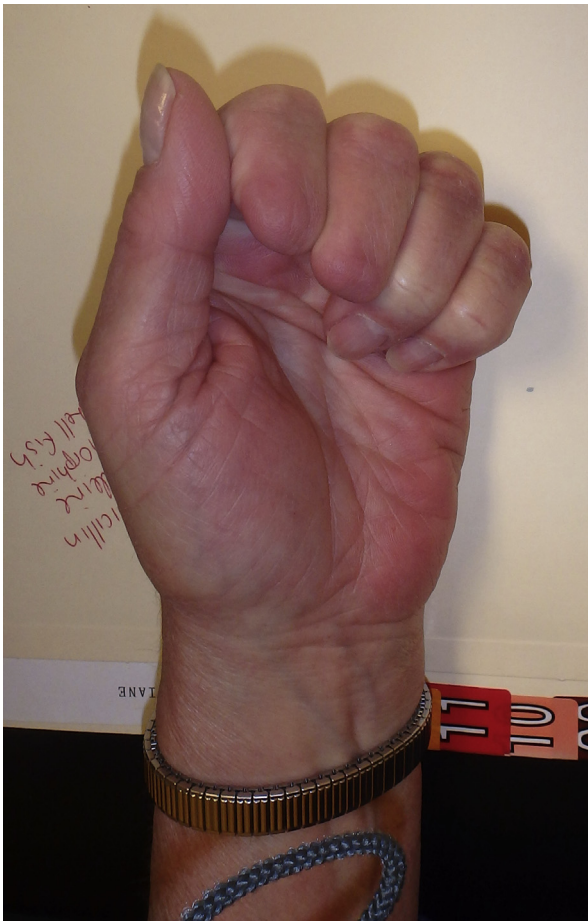


FIGURE 4: Two weeks following the initial procedure, the patient underwent amputation of the gangrenous index and middle fingertips while the ring fingertip was left to heal secondarily. The revision amputation wounds were left to heal secondarily.

operative fingertips. Blisters were noted at the index, middle, and ring fingertips (Fig. 1). Because tissue necrosis was already apparent close to 24 hours after surgery, a decision was made not to use phentolamine rescue. There was progressive demarcation of ischemic necrosis of these fingertips (Fig. 2). Two weeks following the initial procedure, the patient underwent amputation of the gangrenous index and middle fingertips while the ring fingertip was left to heal secondarily. The revision amputation wounds were left to heal secondarily (Figs. 3–5).

DISCUSSION

In 2012, Ravindran and Rajendran⁹ reported a case of digital gangrene possibly caused by 1% lidocaine with 1:100,000 epinephrine. The 19 year-old patient had primary Raynaud phenomenon and was being surgically treated for acute paronychia and a small abscess. The patient developed gangrene on the lateral aspect of the right index finger, which was



FIGURE 5: Two weeks following the initial procedure, the patient underwent amputation of the gangrenous index and middle fingertips while the ring fingertip was left to heal secondarily. The revision amputation wounds were left to heal secondarily.

managed conservatively. No phentolamine rescue was performed.

In 2014, Ruiter et al¹⁰ reported a case of a finger amputation following lidocaine and epinephrine injection in a healthy 16-year-old female, undergoing wart removal under local anesthesia. The radial and ulnar aspects of the middle phalanx had been infiltrated with local anesthesia. Ischemic changes and subsequent necrosis developed and a distal phalangeal level amputation was required. The authors do not specify the concentration or volume of the lidocaine-epinephrine preparation. They do make the point that phentolamine rescue was not attempted and that it should have been performed if the problem was indeed caused by the epinephrine vasoconstriction.

In 2015, Hutting et al¹¹ published a case report of a 70-year-old woman patient with type 2 diabetes mellitus and x-ray findings of calcifications suggestive of atherosclerosis who underwent injection with 1% lidocaine with 1:100,000 epinephrine for a trigger finger release, resulting in digital ischemia and necrosis. Once again, phentolamine reversal of epinephrine vasoconstriction was not performed.

Our case describes a 63-year-old smoker who had previously undergone trigger finger surgery using lidocaine and epinephrine blocks without complication. On this occasion, her index, middle, and ring fingers were injected with lidocaine and epinephrine in the palmar fat and flexor tendon sheaths. She was sent home with pale fingertips and subsequently had



FIGURE 6: Both ring fingers were injected in the palm of one of the authors of the paper (D.H.L.) at the most distal blue dot with 5 mL of 1% lidocaine and 1:100,000 epinephrine. The left ring finger injection had 2 of the 5 mL injected in the flexor sheath and the remaining 3 mL in the subcutaneous fat. The right ring finger had all 5 mL injected in the fat and none in the flexor sheath. The left ring finger felt an immediate “explosion” of the closed liquid space of the sheath with the pressure of the injection rupturing the sheath all the way to the fingertip. The entire finger immediately became swollen and white along its whole length because of the turgor induced by the local anesthetic fluid. This image is taken 1 hour after injection, when the epinephrine along the entire length of the left finger is generating pallor from vasoconstriction. The right ring finger is not vasoconstricted because the epinephrine is acting only in the palm, and not in the fingertip.

surgical amputation of 2 fingertips with secondary healing of a third fingertip.

In our case, lidocaine with epinephrine was injected into the flexor sheaths as well as in the palmar subcutaneous fat. One of the authors (D.H.L.) does not inject lidocaine with epinephrine into the sheath. There are 3 reasons for this. First, subcutaneous local anesthesia is all that is required for satisfactory analgesia if enough time is given for the anesthetic to become established before making an incision. This generally requires about 30 minutes.¹² Second, sheath injections of local anesthesia are more painful than subcutaneous fat injections.¹³ Third, intrasheath injection of lidocaine with epinephrine sends local anesthesia all the way to the fingertip through the sheath and then “explodes” the sheath because it is a closed liquid system. This can produce a swollen, white finger and fingertip (Figs. 6, 7, and Video A; available on the *Journal’s* Web site at



FIGURE 7: Both middle fingers were injected in the palm of one of the authors of the paper (D.H.L.) at the blue dot with 10 mL of 1% lidocaine and 1:100,000 epinephrine. In both fingers, at least 3 mL of the local anesthetic was injected into the sheath and the rest into the subcutaneous fat in the distal palm. As in the sheath injection in Figure 6, the sheath of both fingers was felt to “explode” because the sheath is a confined liquid space. The local anesthetic immediately went to both fingertips via the sheath. The entire fingers immediately became swollen and white along their whole length because of the turgor induced by the local anesthetic fluid. This image is taken 75 minutes after injection, when the epinephrine along the entire length of both middle fingers is generating pallor from vasoconstriction.

www.jhandsurg.org), which is rare in subcutaneous fat injections.

Phentolamine injection to reverse epinephrine vasoconstriction was not performed in our case, although this may have prevented the ischemic necrosis. The ability of phentolamine to reverse epinephrine vasoconstriction in the human finger has been well documented.¹⁴ Phentolamine rescue is carried out by injecting 1 to 2 mg of phentolamine in 1 to 5 mL of saline wherever the epinephrine has been injected. This reliably reverses epinephrine vasoconstriction within 1 hour¹⁴ (Fig. 8 and Video B; available on the *Journal’s* Web site at www.jhandsurg.org).

One of the 3 previously reported cases involved a vasospastic condition, Raynaud phenomenon.⁹ Raynaud phenomenon is described by a well-demarcated cyanosis or pallor of the digits, typically after exposure to cold or stress.^{15,16} The second case had fixed-vessel disease.¹¹ The third case report did not document an underlying vascular condition.¹⁰ Importantly, none of the 3 previously reported cases had phentolamine rescue.^{17–19}

In patients with ischemic fingertips after epinephrine injection, it is also important to rule out the possibility that other causes may have been implicated.



FIGURE 8: These are the same hands as in Figure 7. Right after the photo of Figure 7 was taken, the phentolamine was injected into the right middle finger and saline was injected into the left middle finger. Figure 8 is an image taken of finger perfusion 1 hour after phentolamine rescue of the right middle finger. In the right middle finger where you can see epinephrine vasoconstriction reversal by the phentolamine, 0.5 mg of the drug was injected in 0.5 mL of saline in the midline of each of the proximal and middle phalanges in the subcutaneous fat, 0.25 mg of the drug in 0.25 mL saline went into the fat of the distal phalanx, and 0.75 mL of phentolamine went into the distal palmar fat in 0.75 mL of saline. The same volumes of saline without phentolamine were injected into the equivalent places of the left middle finger. The left middle finger middle and proximal phalanges did not start to pink up until 5 hours after saline injection. The left middle fingertip began to pink up at 2 hours after lidocaine and epinephrine injection.

The most common cause is heat injury in hot water. There are 14 previously reported cases of patients inadvertently burning their own fingers while trying to regain sensation by submerging the digits in hot water.³ Submersion injuries may have blisters and a uniform demarcation line that may be parallel to the water surface. Other causes include a tight bandage or an excessive volume of local anesthesia in the finger causing a compartment syndrome. Only about 2 mL of the lidocaine-epinephrine solution is needed on either side of 1 digit for adequate anesthesia.

Despite the evidence that low-dose digital epinephrine injections are generally safe, this case illustrates that unexpected outcomes are possible. We suggest that lidocaine containing epinephrine be injected in the palmar fat rather than in the digital sheath to decrease the pain of injection and to decrease the risk of the white fingertip. Surgeons

using local anesthetic solutions containing epinephrine in the finger should consider reversing epinephrine vasoconstriction with phentolamine before discharging a patient with a white fingertip.

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