

Delayed- Onset Digital Ischemia after WALANT. A Case Series and Suggested Modification of Phentolamine Reversal

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Abstract

Administration of low-dose epinephrine combined in local anesthesia has been increasingly used in a variety of hand and wrist surgeries performed tourniquet free. Using epinephrine diluted to a low dose (1:100,000) has been reported to be safe in numerous studies. Few cases of finger ischemia were reported in the literature, reversed successfully by the administration of phentolamine. We present a case series of late-onset finger ischemia developed 90 to 120 minutes following local anesthesia with lidocaine and low-dose epinephrine. Local injection of phentolamine divided between the base and tip of the involved finger reversed completely this complication with a significant shortage of fingertip tissue ischemia duration.

Keywords: Local anesthesia; WALANT; low -dose epinephrine; finger ischemia; phentolamine

Introduction

Local anesthesia using lidocaine and low dose epinephrine (1:100,000), has gained increasing popularity in hand and wrist surgery. Creating a bloodless field extended the option to perform complex and time-consuming procedures related to fractures, nerves, and soft tissue operations sparing the use of a tourniquet. A unique advantage of the technique is its ability to estimate the strength and efficacy of a repaired or transferred tendon during the procedure [1-3].

Surgical procedures performed under low-dose epinephrine are considered safe, as confirmed by large and multi-center studies [4-5].

Since 2013 we have used WALANT (Wide Awake Local Anesthesia No tourniquet) in more than 3000 cases for elective and trauma cases with no complication until recently. We present cases that were operated in their fingers under local anesthesia combined with low dose epinephrine. The patients in the study group developed finger ischemia within 90 to 120 minutes from the injection. They all reversed successfully following the local administration of phentolamine.

Case report

Case 1

A 22-year-old heavy smoker and otherwise healthy right-handed male presented to the emergency department with an industrial machine injury of his right index finger. Examination revealed an open midshaft fracture of the middle phalanx with damaged radial digital nerve. The patient was hospitalized for IV antibiotics and was planned for surgery. During 24 hours of monitoring and before entering the operating room the digit was viable.

At the operating room, a solution of 10 ml 2 % lidocaine with 1: 100,000 epinephrine was injected volarly at the level of A1 pulley and proximal phalanx. 30 minutes following injection, an exploration of the flexor tendons was performed, followed by fixation of the fracture with 2 Kirschner wires and suturing of the radial digital nerve. No tourniquet was used during the procedure.

While bandage application and casting of the patient's hand, 90 minutes following the initial injection, a slight grayish appearance of the index tip was noticed. The release of bandages did not change the color, and further deterioration was noted

in the following 20 minutes. The gray color became darker and spread to the middle phalanx. The fingertip turned cold and lost its turgor. No capillary refill was noticed. Warm soaks and removal of the Kirschner wires for decompression did not reverse the digital appearance.

Two and a half hours after initial anesthesia a dose of 2 mg phentolamine with 1mL of 2% lidocaine was injected to the base of the proximal phalanx. 30 minutes following injection gradual improvement was noted initiated at the middle phalanx level and spreading distally. Tip turgor improved gradually over the next 30 minutes. 4 hours following reversal, the finger pulp was warm with a normal capillary refill. At follow up, superficial necrosis at the level of the distal phalanx was noticed (Figure 1A, B). The necrotic layers peeled gradually with no need for skin or graft reconstruction.



Figure 1: A , B. appearance of volar and dorsal aspect of index finger 4 weeks after operation.

Case 2

A 31-year-old right-handed healthy non-smoker male presented to the emergency department with a clean knife laceration involving his right ring and small fingers. An isolated injury to the flexor digitorum profundus (FDP) tendon of the ring finger was diagnosed and surgery was planned. At that time his fingers perfusion was normal.

The patient was operated 3 days following the injury. 20 minutes prior to operation, a solution of 7 ml 2 % lidocaine with 1: 100,000 epinephrine was injected at the volar aspect of A1 pulley and proximal phalanx. During surgery, no tourniquet was used. After the suture of the FDP tendon, the strength of the repair was tested with the patient's full cooperation. Throughout the procedure, the finger color was normal.

While monitoring the patient outside the operating room, approximately 120 minutes after the initial injection, the fingertip became gradually gray and lost its round appearance. The patient was brought back to operating room for the complete release of the cast and bandages. Warm packs did not improve the pulp appearance. At that time capillary refill was absent (Figure 2A).



Figure 2: A. grayish appearance of ring finger pulp 2 hours after local anesthesia

Two hours and fifteen minutes after initial anesthesia, 1 mg of phentolamine diluted in 1 mL of saline were injected to each side of the finger base at the place of former anesthesia. Experienced by the former case, we injected another dose of 0.5 mg of diluted phentolamine directly to the finger pulp. 30 seconds later, the gray color improved (Figure 2B). After 5 minutes, bleeding to pinprick was observed and the pulp regained its turgor. 2 hours after phentolamine injection the finger ischemia was completely reversed and the fingertip was red and warm (Figure 3).

On the first follow-up visit, two weeks after surgery, pulp circulation and appearance were completely normal. The patient had no pain or neuropraxia later on.



Figure 2:b. improvement in color 1 minute after phentolamine injection

Case 3

A 44-year-old right-handed healthy non-smoker female presented to our emergency room with an incidental knife cut of her right small finger. Under WALANT a complete laceration of FDP tendon and ulnar digital nerve was seen and repaired. No complication was noticed perioperatively. On follow-up, the patient was complaining persistently on severe sensitivity over the sutured digital nerve and had difficulty cooperating in rehabilitation. Therefore, 7 weeks later the patient brought again for re-operation.

20 minutes before surgery, a solution of 10 ml 2 % lidocaine with 1: 100,000 epinephrine was infiltrated volarly at the level of the 5th metacarpophalangeal crease and proximal pha-



Figure 3: Normal circulation of finger pulp 2 hours after phentolamine injection.

lanx. On exploration, a small neuroma and adhesions around the ulnar digital nerve were revealed. Neurolysis and wrapping of the nerve with a neural tube were done and the hand was bandaged. 90 minutes after initial local anesthesia the fingertip was slightly grayish and presented a sluggish yet existing capillary refill. The patient was admitted for close monitoring. 5 hours later, the gray color darkened and spread proximally and the fingertip was not bleeding to pinprick (Figure 4 A). Phentolamine was injected in the same protocol, dividing the phentolamine between the original epinephrine injection site and the finger pulp. 1 minute after direct injection to the pulp, it appeared reddish and warm and demonstrated normal shape and capillary refill (Figure 4 B).



Figure 4: A. gray appearance of small finger 5 hours after local anesthesia. B. Several minutes after phentolamine injection.

Discussion

Wide awake local anesthesia with low-dose epinephrine has gained increasing popularity in the office setting or operating room procedures. The benefits of this anesthesia are well appreciated whether for avoiding general anesthesia, eliminating the need for a tourniquet and raising patient's satisfaction, or for better co-operation of the patient when active motion during surgery is needed to optimize results.

Epinephrine is an adrenergic receptor agonist that causes vasoconstriction of blood vessels in the skin and subcutaneous tissues. There are increasing numbers of high-dose (1:1000) epinephrine induced ischemia published in the literature, most of them caused by accidental auto-injectors. The most vulnerable location being involved are the fingers. A significant percentage of patients are children in various ages [6-7]. Fitzcharles-Bowe et al [8] reported on 5 cases of high-dose epinephrine-induced digital ischemia, which resolved spontaneously within 6 hours from the injection. In reviewing the literature, the authors reported various treatment regimens including warm soaks, nitrate paste, and calcium channel blockers. Fingers were described as turning pale, white, or blanched. 14 out of 59 injured fingers were treated with phentolamine reversal in various doses between 0.5- 5 mg, placed in the base of the finger, or in the place of auto-injection. One of the involved fingers demonstrated minimal epithelial peeling with no tissue loss.

Adding a diluted dose of epinephrine (1:100,000) to local anesthesia creates a bloodless field with no need for a tourniquet, thus enables to perform longer and more complicated procedures. There is evidence that supports the safety of this method in hand and finger surgery. In a large prospective multicenter study conducted by 9 hand surgeons, 3110 patients underwent finger and wrist operations with low-dose epinephrine with no complications or need for a reversal [5]. Phentolamine is an alpha- antagonist that competitively inhibits and blocks the effect of epinephrine. It is the most frequently cited treatment for the reversal of digital ischemia. Its short half-life allows repetitive dosage when needed.

In a prospective study conducted by Nodwell and Lalonde [9], 22 subjects including the authors injected 2% lidocaine with 1:100,000 epinephrine to 3 points between A1 and A3 pullies along with their own fingers, with immediate skin blanching. An hour later the same sites were re-injected with saline or 1mg/1mL of phentolamine. An average time of 85 minutes from the injection of phentolamine was needed to regain normal color compared to 320 minutes with saline injection. The

authors recommended injecting 1 ml of phentolamine directly to the point of the formerly injected epinephrine in the setting of epinephrine-induced ischemia.

Zhu et al [10] observed a late-onset digital ischemia 2.5 hours following local epinephrine injection for elective carpal tunnel and trigger finger release of the middle finger. The finger was described as looking dusky. 14.5 hours after the initial anesthesia the patient received 1.5 mg of phentolamine in 1 mL of 2% lidocaine at the base of the proximal phalanx. Marked improvement in color was demonstrated one hour later. 1.5 hours after the phentolamine injection return of circulation was complete. The authors speculated low outside temperatures together with a history of cold intolerance to be contributing factors to this event.

We describe 3 patients which developed delayed-onset finger ischemia 90, 120 and 90 minutes respectively after WALANT with low-dose epinephrine. The first patient presented a history of heavy smoking for 8 years. Phentolamine was injected into the base of his finger. Circulation improved gradually from proximal to distal, with a sequel of necrotic tissues over the distal phalanx. The necrosis was superficial and peeled spontaneously with no permanent damage on follow up. Experienced by this case, in the following cases, we revised our policy. Phentolamine was divided between the base and tip of the finger. This form of injection demonstrated rapid improvement of pulp circulation with no tissue necrosis on follow up. To our knowledge, this form of injection was not described in conjunction with WALANT anesthesia.

Typically, the finger is blanched only where the epinephrine is injected, mostly at the level of the proximal or middle phalanx, sparing the fingertip. For fingertip that appears white longer than expected, Lalonde [2] recommended to inject of 1 mg phentolamine diluted with saline to former epinephrine injected sites. All of our delayed-onset finger ischemia emphasized a "grayish" color similar to that described by Zhu. This was accompanied by a remarkable turgor loss of the pulp. Those separated events could not be explained by low environmental temperature nor by age or past history of peripheral vascular disease.

In our opinion, when observed, this situation should not be left for spontaneous recovery as the extent of pulp ischemia is unpredictable. We raise the question of whether history of heavy smoking should be considered a relative contraindication for WALANT. We recommend including injection of phentolamine directly to the fingertip regardless of the site of original anesthesia.

In conclusion, late-onset ischemia after WALANT is a rare but existing complication. Fingers operated in this technique should be left tip-free when bandaged or casted. Not only blanching as formerly described, but also "grayish" tip with loss of turgor should be given close medical attention. When observed, we recommend reversal with phentolamine divided between the original injection site and the finger pulp to shorten tip ischemia time. This protocol is relevant not only for post-operative cases but also for injured digits anesthetized and treated in the setting of an emergency room or outpatient clinic.

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