

# Epinephrine In Forefoot And Digital Surgery

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## INTRODUCTION

The medical literature has generally discouraged the use of epinephrine in digits for many years. However, upon closer scrutiny of the literature, it appears that the warnings all stem from allegations in the older literature. Prior to 1953, epinephrine and local anesthetics were mixed by hand on a drop by drop basis due to these solution's instability. This fact leads to the suggestion that the complications were a product of inaccurately mixed solutions. Furthermore, it is difficult to locate any specific examples of necrosis or other complications in the literature since the advent of standardized preparation of local anesthetic solutions with epinephrine.

The addition of a vasoconstrictor to a local anesthetic solution has long been an accepted method of increasing the duration of action of many local anesthetic agents, as well as theoretically decreasing the risk of systemic toxicity. These effects have been attributed to the relative isolation of the local anesthetic agent, from the vasoconstrictive action of epinephrine. In addition, the adjunctive use of epinephrine with local anesthetics aids in surgical hemostasis. Thus, the tissue insult and time constraints imposed by using a tourniquet have been eliminated in many common surgical procedures.

The safe use of epinephrine, as an adjunct to local anesthesia, has been reported by many authors. Roth, in 1981, reported on over 2,000,000 injections using various concentrations of epinephrine in local anesthetic digital blocks of the foot. In this study, he reported that even with the highest concentration of epinephrine (1:100,000), the complication rate was only 1 in 60,655 injections (0.017%). Fifty-percent of these complications resolved with "adequate treatment measures." In this study, complications were defined as significant tissue necrosis or gangrene.

## COMPLICATIONS

Generally, complications with the use of epinephrine and local anesthetics include an elevated heart rate, feeling of anxiety or apprehension, palpitations, and increased rate of respiration. Most of these complications can be attributed to intravascular deposition of the anesthetic. These complications can readily be avoided with a proper injection technique, knowledge of the local anatomy, and frequent aspiration during the injection procedure.

The most feared complication associated with the use of epinephrine in digital anesthesia is gangrene secondary to tissue ischemia. This fear is due to the preponderance of negative allegations in past medical literature, that the use of epinephrine in digits "may lead to vasospasm and gangrene"<sup>1</sup> or "produce ischemia which may lead to necrosis"<sup>2</sup>. It is interesting to note that in spite of these allegations, the literature fails to yield any specific case reports of complications arising secondary to the use of epinephrine in digits.

## EFFECTS OF EPINEPHRINE ON TISSUE PERFUSION

Physiologically, epinephrine in peripheral tissues causes vasoconstriction by acting directly on the alpha-adrenergic receptor sites of smooth muscle in vessel walls. Experimentally Scarlett, Walter, and Bachman<sup>3</sup> found that this transient ischemia, which peaked at approximately 14% of pre-injection flow, was found to be reversed by the end of one hour to pre-injection levels. In fact, in the 2-3 hour post-injection time period, there was found to be a relative hyperemia which equalized the flow of the plain lidocaine group. Therefore, the suggestion has been made that for the average patient, the use of epinephrine in digital anesthesia was safer than the use of a tourniquet, since the tissue is never completely deprived of circulation. In addition

with epinephrine, the area of reduced blood flow is confined to the theoretical surgical site.

The use of epinephrine has been found to be a safe and beneficial adjunct to local anesthetic preparations by members of the Podiatry Institute. In approximately 20 years of use of epinephrine in the concentration of 1:100,000 and 1:200,000, only one patient has been readmitted for complications secondary to the use of epinephrine. In that case, it was later shown that the patient had a history of a vasospastic disorder which was not elicited during the preoperative history and physical.

The most frequent adverse effect observed at the author's institution with the use of epinephrine is an occasional patient with postoperative cyanosis of a lesser digit. With same day surgery patients, discharge may be delayed until return of normal digital circulation is observed. A return to the normal pink hue of the digit is usually noted within a few hours. It should also be noted, however, that in spite of this transient cyanosis, capillary refill is usually only slightly delayed.

Standard treatment for a cyanotic digit in the postoperative period at the author's institution consists of withholding cryotherapy and elevation until normal circulation has returned. In more severe cases, a posterior tibial nerve block using plain lidocaine may also be employed to speed the return of capillary circulation.

## CONTRAINDICATIONS

The most obvious contraindication to the use of epinephrine in digital anesthesia is a patient with a known history of vasospasm such as Raynaud's disease, or a previous thermal injury such as frostbite. Reinesch and Myers<sup>4</sup> also showed that epinephrine should be used in more dilute concentrations in skin flap and skin graft surgery. This theory might also apply to areas of previous surgery, especially if extensive tissue trauma resulted.

Other contraindications may include a hyperthyroid patient, since these patients are extremely sensitive to catecholamines. Other groups have argued that the use of epinephrine as an adjunct to local anesthesia should be avoided in patients with significant ischemic heart disease. This is a topic of mixed opinion in the literature, however, and most authors feel that the small amount of epinephrine used in a peripheral block is of no consequence in the cardiovascular patient<sup>5</sup>.

Other exogenous relative contraindications include the concomitant use of Halothane for general anesthesia, since Halothane sensitizes the myocardium and may predispose the patient to arrhythmias. In 1993, however, this is not a widespread problem, as most general anesthetic cases performed use Forane as the inhalational anesthetic. If Halothane is used, then extra care should be exercised in the injection procedure to insure that the local anesthetic is deposited only in the extravascular space. Conversely, although phenylephrine is strongly contraindicated in patients receiving monoamine oxidase inhibitors (MAO), epinephrine is not since there is a different mechanism of enzymatic degradation. An additional relative contraindication may include patients receiving adrenergic blocking agents, such as Bethanadine, for the treatment of hypertension.

When considering the safety of the use of epinephrine as an adjunct to local anesthetic agents, the surgeon should understand the effect and duration of action of the epinephrine. Several plethysmographic studies performed with various local anesthetic agents and concentrations of epinephrine have shown that there is an initial vasoconstriction with epinephrine, which is followed over the next few hours by a relative reflex hyperemia, similar to what might be seen after the release of a tourniquet. In addition to the short duration of vasoconstriction secondary to the epinephrine, there is also the obvious advantage of restriction of vasoconstriction or transient ischemia solely to the operative site, as opposed to insulting surrounding tissue as is experienced with complete deprivation of nutrient supply distal to a tourniquet.

## SUMMARY

Epinephrine should be considered a safe and beneficial adjunct to local anesthetic agents in the properly selected individual. Furthermore, epinephrine may be safer than a tourniquet since, even at its maximal effect, there is never complete deprivation of the tissue's metabolic needs. Also, there is no threat of nerve damage secondary to tourniquet pressure, or the time constraint of a tourniquet clock. Although epinephrine is only an adjunct to the surgeon's armamentarium, it is one that through appropriate patient selection, may be used safely and without undue concern.

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## REFERENCES

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