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Effect of Epinephrine with Local Anesthesia Used in Carpal Tunnel Release on Operative Time, Surgical Site Infection, and Postoperative Pain

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Abstract

Epinephrine is the basis for local infiltrative anesthesia without tourniquet (LIAWE), which creates a comparatively bloodless area. This research sought to ascertain if epinephrine had any impact on bleeding or surgical time during carpal tunnel release (CTR) procedures, including whether electrocautery or a tourniquet were required. It was postulated that local anesthesia, devoid of epinephrine, is a safe substitute for CTA and extends the duration of surgery. Analysis was done on every patient who had CTR under local infiltrative anesthesia between December 2022 and June 2024. 5 cc of 2% lidocaine (local infiltrative anesthesia, no epinephrine [LIANE] group) or 5 cc of 2% lidocaine with 1:100,000 epinephrine (8.4%) (LIAWE group). It was determined how long it took for the skin to close after the incision. Information about the use of tourniquets, electrocautery, and surgical complications was documented. Of the 64 patients who had CTRs, 30 were done under LIANE and 34 under LIAWE. The skin-skin time was 8.6 minutes (6–14 minutes, standard deviation [SD] =3.3) for LIAWE and 14.5 minutes (9–26 minutes, SD =3.5) for LIANE. The skin-skin time difference between the two groups was 40%, which was a significant difference. Six hours after surgery, there was a noticeable difference in discomfort between the two groups. No tourniquet was employed, and no patients required electrocautery. No complications occurred during the procedure. Without epinephrine, the procedure took 40% longer. While widespread awake anesthesia does not need epinephrine, it does have the extra benefit of reducing surgical time.

Keywords: *carpal tunnel syndrome, carpal tunnel release, LIAWE, epinephrine, local infiltrative anesthesia with no tourniquet*

Introduction

The most frequent entrapment neuropathy in upper extremity surgery is Carpal Tunnel Syndrome (CTS), which is caused by ischemic dysfunction and mechanical compression of the median nerve at the wrist level in the fibro-osseous carpal canal [1]. Patients with this condition frequently experience a gradual onset of paresthesia and dysesthesia, loss of grip strength, and nighttime pain that is distributed along the median nerve's sensory distribution and can significantly impair hand function [2]. When conservative treatment approaches (such as night splinting, activity modification, physical therapy, and local corticosteroid injections) fail to prevent degenerative neurologic changes and fail to produce a long-lasting symptomatic benefit, surgical correction is necessary [3]. In order to relieve compression and restore intraneural blood supply for nerve repair, a thorough incision of the transverse carpal ligament is made during carpal tunnel release, which has long been regarded as the gold standard approach for surgical decompression of the median nerve [4].

In the past, Carpal Tunnel Release was carried out in a typical operating room setting using standard anesthetic methods such as intravenous regional anesthesia, nerve block to the upper arm, or a brief general anesthetic. To keep the surgical field bloodless, a tourniquet was then applied to the upper arm [5]. Although the use of a pneumatic tourniquet is effective in ensuring good visualization, there may be inherent clinical challenges, such as the presence of severe ischemic arm pain, bruised muscle, and temporary nerve compression, which often necessitates the use of higher systemic doses of analgesics or intravenous sedation [6]. Pre-anesthetic testing, post-anesthetic monitoring, and scheduling in the main operating room all entail higher health care resource utilization, patient wait times, and operation costs [7].

Due to the widespread use of the Wide-Awake Local Anesthesia No Tourniquet (WALANT) approach during the last 20 years, hand surgery has undergone a paradigm change [8]. The widespread use of the Wide-Awake Local Anesthesia No Tourniquet (WALANT) approach has caused a paradigm change in hand surgical practice during the last 20 years [9]. Before the skin is sliced, a little amount of epinephrine and lidocaine, a topical anesthetic, are administered directly into the surgical site [10]. The strong alpha-1 adrenergic vasoconstrictive effects of epinephrine, which temporarily reduce blood flow to the surgical field's microvasculature and provide a clear surgical field without the need for a tourniquet on a limb, are the physiological basis of this technique [11]. There is enough evidence that low-dose epinephrine is safe in hand and finger operations and may be utilized in common outpatient surgical procedures such a Carpal Tunnel Release, despite several misconceptions about the possibility of epinephrine causing necrosis of the digits [12].

When compared to other inaesthetic techniques, there are still some subtle clinical questions regarding whether the use of epinephrine with local an aesthetic affects significant perioperative outcomes [13]. Among other things, the hemostatic control characteristic of epinephrine may make tissue dissection easier, minimize intraoperative cauterization, prevent delays in tourniquet preparation, and speed up room turnover after the surgery. However, there is some uncertainty regarding whether local microvascular vasoconstriction would impact the surrounding tissues' capacity to supply oxygen and nutrients to the surgical site or whether it would impact the local tissue defense mechanisms, thereby raising the risk of surgical site infection or delaying wound healing [14], [15]. Rebound pain is still a major factor in patient satisfaction and post-discharge demand for analgesics, but the route of systemic absorption of the local anesthetic following epinephrine should be thoroughly investigated because epinephrine prolongs the duration of sensory blockade [16].

The purpose of this study was to evaluate how epinephrine affected the carpal tunnel release (CTR) time, bleeding, and the need for a tourniquet or electrocautery during the procedure. The idea was that, although it would take longer, local infiltrative anesthesia without epinephrin [LIANE] would be an appropriate method for CTR.

Materials and Methods

Patient consent was obtained before inclusion in the study. A retrospective review was performed on patients who underwent carpal tunnel release (CTR) under local anesthesia without the use of a tourniquet between December 2022 and June 2024. Patients were considered eligible when they had experienced symptoms attributable to carpal tunnel syndrome for a minimum of three months and had failed to obtain adequate improvement following conservative management. Conservative treatment consisted of six weeks of wrist splinting together with a steroid injection. Patients requiring any additional or concomitant surgical procedure were excluded from the study.

For each patient, demographic and operative information was systematically collected. The recorded variables included age, sex, operated side, time required for local anesthetic injection, duration from skin incision to completion of skin closure, use of a tourniquet, use of electrocautery, and the occurrence of intraoperative complications, particularly iatrogenic nerve injury. The skin-to-skin operative duration was defined as the number of minutes elapsed between the initial skin incision and final skin closure.

Before surgical preparation, local anesthesia was administered subcutaneously along the planned incision and within the inter-thenar region. Patients allocated to the lidocaine with epinephrine group (LIAWE) received 5 cc of 2% lidocaine containing epinephrine at a concentration of 1:100,000, whereas those in the lidocaine-alone group (LIANE) received 5 cc of 2% lidocaine without epinephrine. The affected upper limb or limbs were then prepared using the standard surgical protocol. After allowing approximately 10–15 minutes for the anesthetic to take effect, a mini-open carpal tunnel release was performed. When bleeding from a vessel interfered with adequate visualization, a retractor was applied to the operative area only for the minimum period required to complete the release. No specific hemostatic technique was routinely employed, and skin closure represented the only consistently performed method of achieving hemostasis.

Postoperative assessment was conducted at two designated follow-up intervals, namely two weeks and six weeks after surgery. For statistical analysis, continuous variables were compared using the independent t-test, while categorical data were analyzed using the Chi-square test. Statistical significance was established at a P value of ≤ 0.05.

Result and Discussion

Results

A total of 64 patients underwent carpal tunnel release during the study period. Based on the type of local anesthetic administered, 34 patients received lidocaine combined with epinephrine (LIAWE), whereas 30 patients were treated with lidocaine alone (LIANE). The study population consisted predominantly of women, with 49 female and 15 male patients. The participants ranged in age from 23 to 57 years, with a mean age of approximately 40 years. Baseline comparisons demonstrated that the LIAWE and LIANE groups were comparable with respect to the principal demographic characteristics. No statistically significant differences were identified between the groups regarding patient age, sex distribution, or the side of the operation, indicating adequate comparability of the groups at baseline (Table 1).

A notable difference was observed in the duration of the surgical procedure, as assessed by the skin-to-skin operative time. In patients receiving lidocaine with epinephrine, the mean skin-to-skin duration was 8.6 ± 3.3 minutes, with individual procedures requiring between 6 and 15 minutes. In contrast, procedures performed using lidocaine without epinephrine required considerably more time, with a mean duration of 14.5 ± 3.5 minutes and a range of 9–26 minutes (Table 2). Thus, omission of epinephrine from the local anesthetic was associated with an absolute increase of 5.9 minutes in the mean operative time, corresponding to approximately 40% longer surgery compared with the LIAWE group. This difference was statistically significant (Table 3).

Importantly, neither group required the application of a tourniquet or electrocautery during the procedures. No intraoperative complications were recorded in either treatment group. The postoperative course was also uncomplicated, with no cases of hematoma formation, wound dehiscence, or surgical-site infection identified during follow-up in either group (Figures 1, 2, 3).

Table 1. Study Groups

Group A n = 34	Male 7	Female 27	Mean age 43.29
Group B n= 30	Male 5	Female 25	Mean age 45.32

Table 2. Operative time

	Group A	Group B
Mean Operative time	8.6 mins	14.5 mins

Table 3. VAS out of 10

	Group A n=34	Group B n=30	P value
2 hours	1.85	1.95	
4 hours	2.21	4.9	
8 hours	3.54	5.85	

Figure 1. Inter thenar space injection

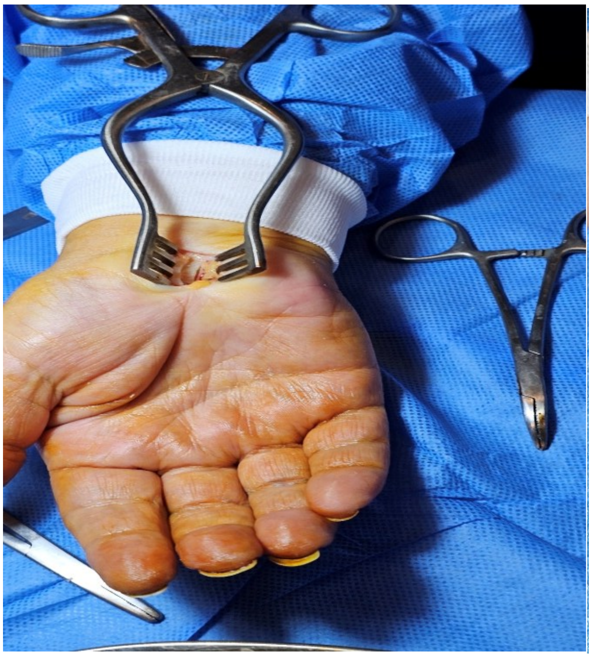

Figure 2. Bloodless field with retractor

Figure 3. Small incision with good hemostasis

Discussion

Along with ganglion cyst removal, soft tissue mass removal, first dorsal compartment release, and trigger finger release, carpal tunnel release using LIAWE has gained popularity over the last ten years. LIAWE is a more complex treatment involving flexor tendon repair and trapeziectomy, but it has some advantages, such as the capacity to be carried out in a non-tourniquet context [17], [18], [19], [20], [21]. Since the tourniquet is not required, there is no need to sedate, keep an eye on the procedure, or get IV access in the main operating room—all of which would be required if it were. Because there is no conscious sedation, LIAWE offers additional benefits to outpatient surgical case flow in terms of efficiency and cost savings.
The idea of LIAWE is to secure a surgical field without the need of an arm tourniquet by using epinephrine to cause vasoconstriction and a bloodless surgical field. Although lidocaine and epinephrine were not traditionally injected into the fingers, they are now frequently used for digital and hand anaesthesia.2 Because lidocaine with epinephrine has a 1000-fold higher acidity than standard lidocaine injection, sodium bicarbonate is frequently used to buffer the injection [22].
There are a number of reasons why LIANE is feasible. The pressure hemostatic action of the self-retaining retractor is evident. Usually, the bleeding comes from beneath the skin and occurs at the edge of the incision. Deeper tissues may also be the source of bleeding; the self-retaining retractor may provide the tension needed to halt this bleeding. Hemostasis may also be aided by the injection's tumescence effect, which raises the local pressure in the subcutaneous tissue. The surgeon's comfort level and familiarity with soft tissue bleeding is the fourth, less evident, but perhaps more important aspect. The use of tourniquets, which by default creates a dry field, is a major component of traditional hand surgery training. This "tourniquet culture" is exclusive to peripheral extremity surgery and does not exist in surgical specialties where tourniquets are not an option [23].
The inclusion of epinephrine resulted in a significant increase in operating time (36% more time), according to the research, and all surgeries were successfully finished. Therefore, the goal of this study is to demonstrate that wide-awake anesthesia does not require epinephrine. At the same time, it documents how epinephrine helps shorten operating times. Based on these results, LIAWE will continue to be our first option for anesthesia, and LIANE will only be used for individuals who have a history of vaso-occlusive illnesses or other contraindications to utilizing epinephrine. When the surgical field is near the digital arteries, as in trigger finger release, this technique is particularly applicable.

Conclusion

The operating time increased by 36% in the absence of epinephrine. While wide awake anesthesia does not need epinephrine, it does have the extra benefit of reducing surgical time and intraoperative bleeding, which keeps the surgical field dry. Additionally, the quantity of analgesic medications and the visual analogue pain score at 2, 4, and 8 hours after surgery are decreased when epinephrine is used in conjunction with LIA.
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