Review Article

Intraoperative Hemostasis Using WALANT Versus Tourniquet; A Focused Review on Carpal Tunnel Syndrome and Trigger Finger Release

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Received: 1/16/2024
Accepted: 6/25/2024

ABSTRACT

Maintaining intraoperative haemostasis is crucial when conducting wide-awake hand surgeries, this is particularly to improve visibility which will improve patient's outcome. There are various methods that could achieve the aforementioned, some of which is wide awake local anaesthesia without tourniquet (WALANT) or Tourniquet alongside sedation. Each method has its own benefits and drawbacks. This study primarily focuses on Carpal Tunnel Syndrome and Trigger Finger release. A comprehensive literature review was conducted through PUBMED, Scopus, google scholar, and web of science. A total of 45 articles were included in the study. We aimed to assess whether the literature supports the use of a tourniquet alongside sedation, or only local anesthesia and epinephrine in wide awake hand surgeries. Moreover, we aimed to highlight the benefits and drawbacks of using a tourniquet, and determine the patient population most likely to benefit from tourniquet application.

KEYWORDS
Tourniquet; Wide-awake hand surgeries; Carpal Tunnel; Trigger Finger

Please cite this paper as:
Alnojaidi T, Alaqil S, Alqahtani R, Albraithen G, Almutairi R, Khubrani A, Alhadlaq A. Intraoperative Hemostasis Using WALANT Versus Tourniquet; A Focused Review on Carpal Tunnel Syndrome and Trigger Finger Release. World J Plast Surg. 2024;13(2):3-10.
doi: 10.61186/wjps.13.2.3

INTRODUCTION

Intraoperative hemostasis is a crucial consideration in wide-awake hand surgeries, such as carpal tunnel release and trigger finger release, to minimize bleeding and improve visibility. Although using tourniquet along with local anesthesia and epinephrine is custom in many surgical procedures of the hand, the necessity of tourniquet use remains widely debated [1-3]. Despite the prevalence of hand surgeries, a wide variation within the approach utilized by various surgeons has been noticed.
While some surgeons use a tourniquet as an adjunct to local anesthesia and epinephrine, other surgeons rely solely on local anesthesia and epinephrine for hemostasis without a tourniquet in a technique commonly referred to as "Wide-awake Local Anesthesia No Tourniquet" (WALANT) [4,5]. This raises a question on the optimal approach to

[DOI: 10.61186/wjps.13.2.3]

achieve adequate hemostasis and improve surgical outcome. Several studies have investigated the use of tourniquets in carpal tunnel release and trigger finger release surgeries. In most cases, using a tourniquet is unnecessary, as local anesthesia with epinephrine is usually enough for hemostasis [6]. The use of a tourniquet could be beneficial in specific cases, such as instances where excessive bleeding is expected or when the surgeon is unfamiliar with the procedure [7]. Furthermore, some studies have reported additional benefits when using a tourniquet specifically in a carpal tunnel or trigger finger release surgeries. Using a tourniquet minimized bleeding and significantly improved the visibility of the surgical field in carpal tunnel release surgeries [8]. The use of tourniquet reduces the risk of complications in trigger finger release surgeries [9].

Despite the significance of this topic, there remains a lack of a comprehensive review of the current recommendations within the literature. In summary, the literature is mixed on whether the use of tourniquet in carpal tunnel release and trigger finger release surgeries is necessary, and the topic remains a controversy in the real-world setting. Therefore, we aimed to assess whether the literature supports the use of a tourniquet alongside sedation, or only local anesthesia and epinephrine in wide awake hand surgeries, primarily focusing on carpal tunnel and trigger finger release procedures. Moreover, we aimed to highlight the benefits and drawbacks of using a tourniquet, and determine the patient population most likely to benefit from tourniquet application.

METHODS

In this comprehensive narrative review, we systematically sourced articles from various databases including; PUBMED, Scopus, google scholar, and web of science. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Fig. 1). To ensure data accuracy, our team of four authors meticulously scanned the retrieved articles, removing duplicates.

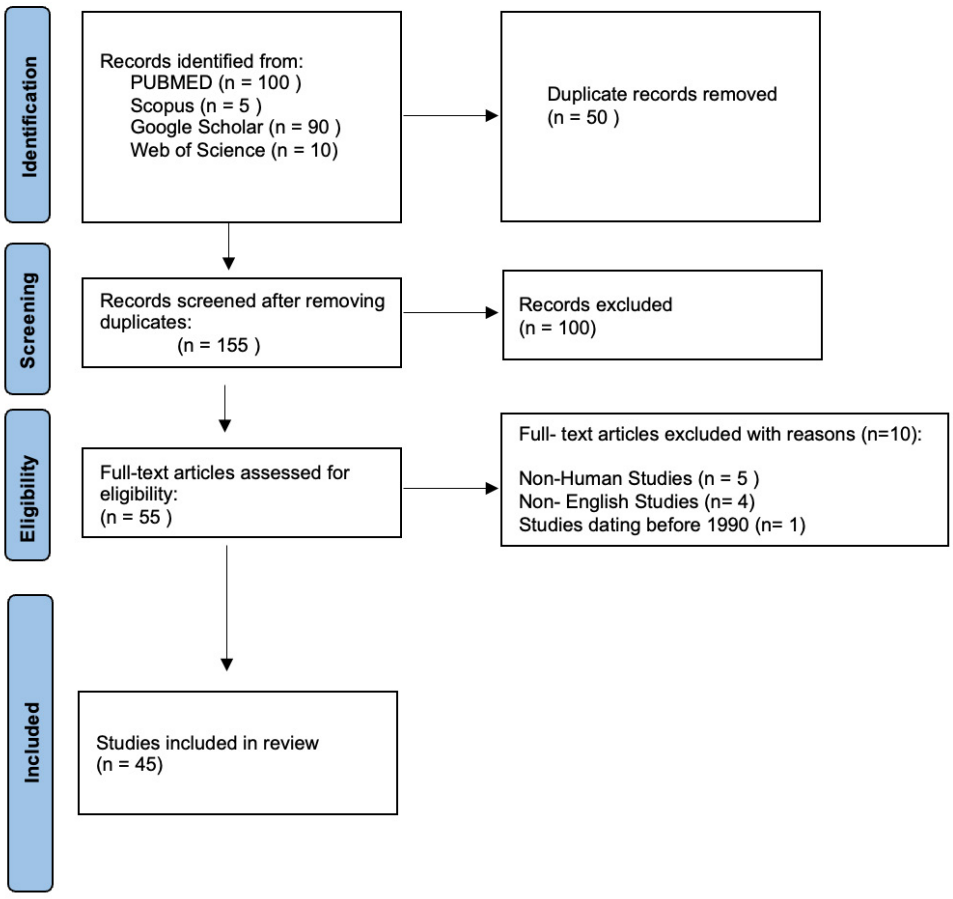

Figure 1: PRISMA flowchart illustrating the study selection process. The diagram outlines the number of studies identified, screened, assessed for eligibility, and included in the review, along with the reasons for exclusion at each stage

[DOI: 10.61186/wjps.13.2.3]

After this rigorous selection process, a total of 45 relevant articles were identified. Keywords that facilitated the search were; "Tourniquet in Hand Surgery", "Intraoperative Hemostasis", "Wide-awake Local Anesthesia No Tourniquet", "Carpal Tunnel Surgery", and "Trigger Finger Surgery". Any article that tackled intraoperative hemostasis whether by WALANT or tourniquet were included in the study. We excluded non-human studies, non-English studies, and studies dating before 1990. It is important to note that this review focuses mainly on Carpal Tunnel and Trigger Finger as the key surgical procedures.

Hand Surgery with Tourniquet

Tourniquet use dates back to 600 B.C., with historical roots attributed to Sushruta, the father of surgical art and science, used a piece of leather to press arteries in order to prevent arterial bleeding [10]. Fast forward multiple years, in 1873; Johann Friedrich August von Esmarch, professor of surgery at Kiel University, proposed a flat rubber bandage which is currently known as Esmarch bandage/tourniquet [11]. Harvey Cushing, thereafter invented the pneumatic tourniquet, inspired by the blood barometer following multiple neurological complications that resulted from Esmarch band use [12].

Maintaining a bloodless field is crucial in patient's diagnosed with Carpal tunnel syndrome, Trigger finger undergoing surgery [1]. This is usually achieved by the application of a tourniquet. Generally, two types of tourniquets are employed: Non-inflatable (Esmarch band) and inflatable (Pneumatic tourniquet) [13]. Pneumatic tourniquet promotes better surgical field and more proper surgeon visualization, and less neurological complications therefore it is more commonly used nowadays [14]. Controversy exists regarding the location of tourniquet application, Hutchinson DT et al. postulates that the forearm tourniquet was tolerated an average of 13 minutes (45%) longer and was consistently rated as less painful compared to arm tourniquet [15]. There was no statistical significance between arm and forearm tourniquet [16].

Over the years, tourniquet use has waned due to reported complications, most notably post-operative pain attributed to mechanical compression and ischemia reperfusion mechanism [17]. To tackle the aforementioned, several meticulous anesthetic measures are implemented such as, Bier blocks and brachial plexus blocks, as well as general anesthetics, which all carry potential risks and side effects [18]. Another common complication is neuronal injury, although most of them are temporary and reversible, the injury could range from simple paresthesia to permanent paralysis [19]. Additionally tourniquet use increases the risk of deep vein thrombosis and pulmonary embolism [20]. For conscious patients, tourniquet tolerance time averages 18 minutes (ranging from 10-26 minutes). While this duration is generally sufficient for procedures like Carpal Tunnel Syndrome release, it may limit the available time for surgery, especially in cases where complications arise [21]. Several contraindications exist, them being, sickle cell disease and peripheral vascular disease; which promotes the use of other measures to maintain a bloodless surgical field due to an increased risk of ischemia and necrosis [22].

WALANT "wide awake local anaesthesia without tourniquet"

During the early 2000s, Dr. Donald Lalonde, a hand surgeon from Canada, pioneered the "wide awake local anesthesia with no tourniquet" (WALANT). This technique has become increasingly popular in various surgeries due to its numerous advantages [23]. By utilizing lidocaine and epinephrine for anesthesia and hemostasis, respectively, WALANT eliminates the need for sedation and a tourniquet, making the procedure safer for patients [24].

WALANT also creates a bloodless surgical area, which provides clear visibility to surgeons, enabling more accurate incisions and better outcomes. The technique allows patients to move their fingers during the surgery, improving communication between the surgeon and patient and resulting in better surgical precision. Additionally, WALANT reduces postoperative pain, minimizing the need for opioid pain medications and leading to quicker recovery time and improved patient satisfaction [25]. This cost-effective technique is suitable for outpatient clinics, allowing patients to return home on the same day of surgery and resume their daily activities. It also reduces the risk of complications associated with general anesthesia, making it a safer option for patients with underlying medical conditions [26].

While WALANT is considered as a safe and

[DOI: 10.61186/wjps.13.2.3]

effective option for many patients, it is imperative to acknowledge potential complications and contraindications associated with the procedure. Fainting secondary to a vasovagal response, increased anxiety in patients who fear being awake for the procedure, and jitters are common side effects of WALANT. Additionally, infrequent adverse effects such as lidocaine hypersensitivity and epinephrine-induced cardiac ischemia may occur [1]. Patients with peripheral vascular disease or those who are anxious may also be at increased risk for complications. Furthermore, patients who are uncooperative, particularly children, are an absolute contraindication for the use of WALANT [1].

The epinephrine myth (epinephrine safety for injection in digits)

Epinephrine's effect on hemostasis, injection pain, anesthetic effect, and other factors are all affected when it is utilized in wide-awake local anesthesia without tourniquet (WALANT). Epinephrine can be used for hemostasis without the need for a tourniquet [1]. Epinephrine was formerly prohibited from being used during finger procedures due to problems. It has been established that expired procaine was the cause of the necrosis of the fingers. Epinephrine has recently been shown to be safe and effective in hand surgery in a number of trials [8].
Epinephrine promotes hemostasis and lengthens the anesthetic effect's endurance. The vasoconstriction effect results in a bloodless surgical field, and the longer duration of anesthesia is brought about by decreased perineural drug clearance, which is a side consequence of the vasoconstriction-induced reduction in regional blood flow[1]. Tumescent lidocaine and epinephrine injection for wide-awake hand surgery has two rather typical issues. If the surgeon anticipates them and takes precautions, they are readily dealt with. The first is the jittery, quivering feeling that anybody may experience after receiving an adrenaline injection. This sensation won't last long on its own and is not considered an allergic reaction to the local anesthetic. A vasovagal episode is the second frequent issue. By injecting patients while they are lying in a supine position as opposed to sitting upright, the vasovagal reaction is reduced. A vasovagal episode is effectively handled by various physical manoeuvres, of which is squatting, often described as bending the knees and hips to swiftly get blood from the thighs to the brain. Another manoeuvre is leg crossing with muscle tensing which was proven to be effective in aborting 7 out of 8 vasovagal attacks [27].
Epinephrine in the finger is currently widely known to be safe. In the late 20th century, fingers were lost owing to the acidity of procaine which was injected concurrently with epinephrine, leading to the creation of "The Epinephrine Myth". It is a fact that epinephrine causes vasoconstriction to obtain hemostasis, but epinephrine per se will not cause necrosis of the fingers if injected correctly and cautiously; there have yet to be any instances of finger necrosis related to unintentional finger injections of high dosage (1:1000) of epinephrine. Additionally, Phentolamine serves as an antidote in case epinephrine action needs to be reversed, which is through the subcutaneous injection of 1 mg of phentolamine in 220 cc of saline wherever the epinephrine is injected. Phentolamine is rarely used in clinical practice, even when the proximal finger displays vasoconstriction, due to the fact that this is rarely severe enough to lead to digital necrosis. However, if the fingertip has adequate blood flow before surgery, it will likely continue to have normal blood flow during surgery unless the surgeon accidentally impairs the blood flow during the dissection [5].

Current evidence & recommendation in WALANT:

In the current practice, WALANT is not recommended as an option for any vascular diseases such as sickle cell patients since the epinephrine may enhance the adhesion of the sickled erythrocytes leading to a Vasoocclusive crisis [28]. Similarly, patients with Raynaud disease, scleroderma, Buerger disease, vasculitis, or patients with severe preoperative ischemia or reduced peripheral circulation as a result of prior vascular injury should be detected and potentially disqualified from performing WALANT [29]. Moreover, WALANT operation should not be performed on patients who are allergic to lidocaine. The presence of a real allergy to amide local anesthetics, which is extremely unusual, must be taken into consideration with regard to the patient [30]. In addition, patients who are uneasy or unable to cooperate, have an infection that is still active, have a phobia of needles, have abnormal clotting profiles or bleeding disorders are other

[DOI: 10.61186/wjps.13.2.3]

situations in which WALANT should not be used [31]. Given the COVID-19 epidemic, there has been an increasing interest in WALANT methods. 16 patients who received WALANT hand procedures without incident during the height of the COVID-19 pandemic were discussed already [32]. In addition, 72 patients who underwent WALANT operations during the COVID-19 epidemic in New York City were reported by Kurtzman et al [23], likewise without further complications. These publications illustrated that, in times of resource scarcity or when primary operating rooms are unavailable and ventilatory support is allocated for patients with more serious demands, WALANT surgery offers a secure option for hand surgeries.

Carpal tunnel syndrome and trigger finger release using WALANT vs Torniquet

There are numerous aspects that should be considered when comparing the use of WALANT vs. torniquet in hand surgery, specifically in Carpal Tunnel Syndrome and Trigger Finger release. These include cost savings, complications, pain control and satisfaction. The literature demonstrates that WALANT has an optimum profile when considering the outcome as compared to torniquet use. Regarding cost savings, WALANT permits conducting the procedure in a clinic-based/office setting rather than an operating room, Leblanc et al. displayed a reduction in 1/4th of the cost when the CTS release is conducted in a clinic [33]. Likewise, Kazmers et al. demonstrated a 6 fold reduction in cost when CTS release in conducted in an office based setting [34]. Similarly Alter et al. compared the cost in USD, which showed an overall cost of 89.12 vs 1409.2 USD, when using WALANT and IV analgesia respectively [35]. Complications can include; the rate of infection and overall bleeding. Even when CTS and trigger finger release is conducted in office based settings, sterility measure are upheld, hence there are no current studies demonstrating a higher rate of infection when using WALANT in a clinical setting compared to torniquet use in an operating room [36,37]. Similarly, Kardestuncer et al. expressed that patients undergoing trigger finger release using WALANT only had minor complications (superficial infection, stitch abscess, and localized cellulitis) which was similar to patients undergoing the release in the operating room [38]. There are controversies when it comes to the risk of bleeding, some studies showed a slight increase (1 ml) when comparing WALANT to tourniquet use in CTS release [39]. Olaiya et al. stated that risk of bleeding was not statistically significant when comparing tourniquet use vs WALANT in CTS release, but rather the tourniquet had higher post operative pain [18]. However, bleeding was slightly lower in the tourniquet group compared to WALANT but overall both techniques achieved adequate haemostasis [2]. Regarding pain control and patient satisfaction, studies concluded that WALANT had better pain control profile, which led to higher patient satisfaction. Far-Riera et al. showed significant reduction in post operative pain in WALANT, which led to using less post operative analgesia [40]. WALANT had a statistically significant reduction of post operative discomfort compared to tourniquet use in hand surgery [41]. WALANT use in CTS release led to the reduction in opioid use compared to other methods such as general anaesthesia, and tourniquet use [25]. Considering all of the aforementioned evidence, it is concluded that WALANT use in CTS and trigger finger release, constitute a higher rate of patient satisfaction as compared to torniquet use.

Dosage, Preparation and Technique (WALANT)

The recommended lidocaine dosage, without the inclusion of epinephrine, is usually around 4-5 mg/kg. However, this dosage may be increased to approximately 7 mg/kg when combined with epinephrine [4]. A common mixture for achieving both analgesia and hemostasis is 1% lidocaine combined with epinephrine at a ratio of 1:100,000 [4]. Nevertheless, other ratios, such as 1:400,000 for wrist tendon repair and 1:1,000,000 for manipulating fractures, have demonstrated effectiveness [42]. To reduce the acidity of the injection and therefore alleviate discomfort, a buffering solution can be prepared by combining 1 ml of 8.4% bicarbonate with 10 ml of the lidocaine-epinephrine mixture [4]. In procedures lasting beyond 2.5 hours, bupivacaine can be incorporated into the mixture [4]. It is advisable to have phentolamine reversal (1 g diluted in 1 to 10 ml of 0.9% normal saline) on standby [43]. The WALANT technique follows three key principles: managing pain through lidocaine, controlling bleeding with epinephrine, and alleviating anxiety via the procedure itself and a calming environment.

[DOI: 10.61186/wjps.13.2.3]

To mitigate the likelihood of a vasovagal reaction, the patient should be lying in a supine position during the injection [1]. The needle should be held steady and inserted perpendicularly to the skin [8]. The solution, up to a volume of 10 ml, should be administered in an antegrade manner just below the skin's surface, ensuring a local wheal of at least one centimeter ahead of the needle tip. For subsequent injections, the needle should be reinserted into areas that have already been numbed. When the procedure is executed correctly, the patient should primarily experience discomfort only during the initial injection [8]. Some limitations of the study include the sparse number of studies reported in the literature regarding this topic, there is still a lack of high level of evidence tackling intraoperative hemostasis. Some RCT that were included were not double-blinded which could impact the level of bias. When comparing WALANT with tourniquet, patients risk factors were not adequately assessed, some articles did not compare patient's characteristic or did not include similar participants risk factors which could result in suboptimal comparison. However, despite these limitations, our study is considered an updated narrative review regarding the topic, we've included articles with a timeframe up to 2023.

CONCLUSION

Intraoperative hemostasis plays a pivotal role in wide-awake hand surgeries, such as carpal tunnel release and trigger finger release, serving to minimize bleeding and enhance visibility. Two principal approaches are employed to achieve intraoperative hemostasis: the use a tourniquet in conjuction with local anesthesia and epinephrine, or depending on local anesthesia and epinephrine for hemostasis without a tourniquet (WALANT), necessity of tourniquet use remains widely debated. Tourniquet use is becoming less popular over the years due to its proposed complications while (WALANT) technique has become increasingly popular in various surgeries due to its numerous advantages over tourniquet. WALANT eliminates the need for sedation and a tourniquet, making the procedure safer for patients a particularly crucial consideration that gained prominence during the COVID-19 pandemic. In the contemporary landscape of hand surgeries, WALANT is considered the cornerstone when conducting CTS and trigger finger release, this due its positive profile when considering cost savings, complications (infection and bleeding risks), post operative pain and overall patient satisfaction.

ACKNOWLEDGEMENTS

The authors did not receive any financial support.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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[DOI: 10.61186/wjps.13.2.3]