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Wide Awake Local Anesthetic No Tourniquet in Hand and Wrist Surgery: Current Concepts, Indications, and Considerations

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Background: Traditionally, the use of a pneumatic arterial tourniquet was requisite for safe and effective surgery of the hand. The use of arterial tourniquets necessitates the use of regional or general anaesthesia. Wide-awake local anaesthetic no tourniquet (WALANT) has emerged as a novel technique to overcome the limitations of tourniquet use in conjunction with regional/general anaesthesia. This review aimed to examine the safety and effectiveness of WALANT and provide guidance for surgeons with limited WALANT experience.

Methods: A literature review of MEDLINE was performed up to March 2021 to identify all articles related to the use of WALANT in hand surgery. Any article reporting original data related to the use of WALANT was eligible for inclusion.

Results: A total of 101 articles were identified through database searching. Of these, 79 met full inclusion criteria and described the use of WALANT in 19 elective and trauma procedures. Current data suggest that WALANT is safe and effective for use in a range of procedures.

Conclusions: WALANT surgery is increasing in popularity as evidenced by the variety of surgical indications reported in the literature. There is limited comparative data on the cost-effectiveness of WALANT compared to conventional methods. Current data suggest that WALANT is safe, better tolerated by patients and associated with direct and indirect cost savings. *(Plast Reconstr Surg Glob Open 2024; 12:e5526; doi: 10.1097/GOX.0000000000005526; Published online 22 January 2024.)*

INTRODUCTION

Traditional hand surgery requires pneumatic arterial tourniquets (AT) to maintain a bloodless field and improve visibility. However, extended tourniquet usage can lead to severe pain, requiring mitigation with either general or regional anesthetic. The wide awake local anesthetic no tourniquet (WALANT) technique can negate this issue by infiltrating an adrenaline-containing local anesthetic (ACLA) into the operative field. Historically, infiltration of adrenaline into an extremity has been discouraged[1] due to the risk of ischemic necrosis in areas perfused by end arteries. Now, there is strong evidence to suggest WALANT is a safe technique and a favorable method of anesthesia for hand surgery. However, the uptake of WALANT remains slow.[1] The aim of this review is to explore the indications for WALANT in hand surgery and outline the benefits of this technique. The barriers to WALANT uptake will be discussed along with practical guidance on how to overcome these.

METHODOLOGY

A search of the PubMed database for all publications in the English language up to March 1, 2021 was performed with the Medical Subject Heading "WALANT." In addition, all eligible studies' reference lists were reviewed to include articles that add to the understanding of WALANT. Full-text review was performed for all selected articles.

Disclosure statements are at the end of this article, following the correspondence information.

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Inclusion Criteria

All studies assessing the use of WALANT in hand surgery were included. In particular, literature on the WALANT indications, the financial benefits of the procedure including direct cost, efficiency, and resource savings, patient benefits, and the disadvantages of the technique were analyzed.

Exclusion Criteria

Abstracts and presentations without full text, reviews not adding new data or insight, papers not published in English language, anatomical locations outside the hand or wrist, and responses to full articles that did not add materially to the literature were excluded.

RESULTS

The literature search identified 101 articles, of which 99 were available for title and abstract review. In total, 27 articles were excluded as per the above criteria. Following a full-text review of the remaining articles and addition of suitable references, 79 articles were finally included (Fig. 1).

The Need for WALANT: AT Complications

Tourniquet pain is the limiting factor in AT use, patients will tolerate discomfort for 18 minutes and 25 minutes on the arm and forearm, respectively.[2] This window of time is often insufficient for complex cases, dealing with unexpected intraoperative findings and for delivering training.[3]

Infrequently, prolonged tourniquet pressure can lead to nerve injury, ranging from paraesthesia to complete paralysis.[4] Other complications include reperfusion injury, friction, and chemical burns.[5–7]

Takeaways

Question: What should a hand and wrist surgeon incorporating wide awake local anesthetic no tourniquet (WALANT) into their practice for the first time know?

Findings: Literature review consistently shows that use of adrenaline in the hand and digits is safe. WALANT is a well-tolerated method of anesthesia and can produce surgical conditions comparable to tourniquet use. WALANT is effective for the gamut of elective and traumatic, bony and soft tissue pathologies. Adoption can lead to considerable cost savings and provide an opportunity to redesign patient pathways to be more time efficient and environmentally friendly.

Meaning: WALANT is a safe, effective, efficient, versatile, and environmentally friendly way to operate on the hand and digit.

Adrenaline Safety in the Hand

The occurrence of ischemic necrosis from infiltrating adrenaline around end arteries has consistently been shown to be vanishingly rare.[8] In 2001, Denkler[9] found sporadic reports of finger necrosis. However, all of these occurred before 1948, when commercial lidocaine-adrenaline mixes were unavailable. Only 48 cases were reported between 1880 and 2000, with the majority occurring before 1950 and only 21 of which involved injection of adrenaline.[10] Krunic[11] later in 2004 also concluded that there were no reports of digital ischemia associated with the use of commercially available lidocaine-adrenaline mixes. Later, in 2007, Thompson[12] reported that cases of digital ischemia in the early 20th century were likely due to cocaine and procaine, commonly used at the time. These agents are now known to degenerate overtime and

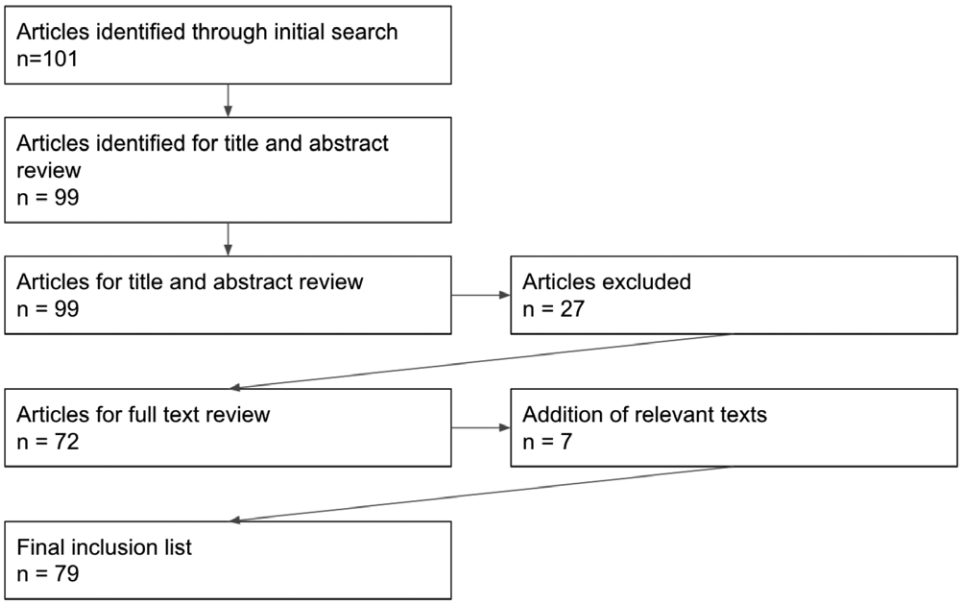

Fig. 1. Study selection and inclusion flowchart.

when improperly stored, can cause severe tissue acidosis.[13] This was likely the cause of digital necrosis rather than adrenaline-mediated vasoconstriction. More recently, it has been shown that injections of 1:200,000 adrenaline into the fingers of 17 patients did not cause critical hypoperfusion to the fingertip.[14]

Fitzcharles-Bowe identified 57 patients who underwent 1:1000 adrenaline injections into the hand. No patient had irreversible ischemic necrosis; however, 13 required treatment with phentolamine[15] (reversal agent for adrenaline-mediated vasoconstriction[16]), which takes approximately 85 min to restore bloodflow.[17] It is widely accepted that all surgeons using WALANT should possess working knowledge of phentolamine,[18] a view our team agrees with. Systemic complications associated with WALANT are rare. Although some cite the theoretical risk of cardiac complications, a study of 51 patients undergoing WALANT found no statistical difference in incidence of arrhythmia between those in the WALANT group and those in the local anesthetic/tourniquet (LA/TQ) group.[19]

Composition of WALANT: ACLA Solutions

A range of ACLA solutions have been described, most containing lidocaine with a low-dose adrenaline.[20] Lalonde originally described a mix of 1% lidocaine with 1:100,000 adrenaline, with a maximum dose of 7 mg per kg of lidocaine.[21] Others add 8.4% sodium bicarbonate to alleviate some of the discomfort associated with acidity of local anesthetics.[22] Some have modified the concentration of lidocaine for more practical reasons: for example, surgeons in Preston use 1.8% lidocaine mixture, which can be easier to reconstitute with the available solutions in the UK.[23] Some have described diluting their mixtures with saline to achieve an adrenaline concentration of 1:400,000, especially in cases requiring larger volumes of infiltrate.[24] Lalonde now recommends a solution of 0.5% bupivacaine with 1:200,000 adrenaline for procedures lasting longer than 2 hours, reducing the need for intraoperative ACLA injections.[18]

Concerns with WALANT: Is It Effective in Creating a Bloodless Field?

Some question WALANT's vasoconstrictive ability and its impact on surgical efficiency and safety, partly explaining its slow uptake amongst surgeons. The absence of a completely bloodless operative field, otherwise afforded by a tourniquet, is generally accepted with WALANT.[25] Gunasagaran has shown no significant difference in estimated blood loss or operative time between WALANT and LA/TQ-based anesthetics.[26] Others have found that WALANT provided a better surgical field than a tourniquet for trigger finger release (TFR) amongst 86 patients.[27]

Efficient surgery under WALANT requires adequate time for adrenaline to produce vasoconstriction. Some quote 26 minutes from injection to optimal visibility.[28] In contrast, others suggest there is no difference in waiting 7 minutes versus 30 minutes after injection,[29] whereas others still found "good enough" visibility was achieved in between 5 and 15 minutes.[30] A balance between surgical efficiency and waiting for optimum vasoconstriction is required, requiring each surgeon to personalize their practice. Novice surgeons or those with limited experience of WALANT may require a period of familiarization—anatomy may be distorted, and the operative field may be wet with ACLA and/or blood. The current literature indicates that for those experienced with WALANT, there is minimal or no difference in operating time, safety, and outcomes in comparison with traditional methods.

INDICATIONS FOR WALANT

Many hand and wrist procedures can be performed under WALANT (Table 1).

Table 1. Published Indications for WALANT SURGERY

Location	Indication	Author(s)
Digit	Phalangeal fracture	Tang,[30] Khor[31]
	Flexor tendon repair/transfer	Gueffier,[32] Mohammed,[33] Woo,[34] Tang,[30] Khor[31]
	Extensor tendon repair/transfer	Miyashima,[35] Abdullah,[24] Mohammed,[33] Woo,[34] Tang,[30] Khor[31]
	Digital nerve	Sawhney,[36] Tang,[30] Khor[31]
	Trigger finger	Mohd,[27] Maliha,[37] Gunasagaran,[26] Hernandez,[29] Codding,[38] Ki Lee,[39] Shulman,[3] Rhee,[40] Tang,[30] Burn[41]
	Digital revascularization	Wong,[42] Khor[31]
	Digital replantation	Wong,[42] Khor[31]
	Skin flap	Xu[43]
Palm	Metacarpal fracture	Feldman,[44] Tang[30]
	Ganglion excision	Gunasagaran[26]
Wrist	Carpal tunnel release	Tulipan,[45] Sraj,[46] Kang,[47] Via,[48] Chapman,[49] Kazmers,[50] Gunasagaran,[26] Hernandez,[29] Ki Lee,[39] Shulman,[3] Rhee,[51] Mckee
	First dorsal compartment release	Ki Lee,[39] Shulman,[3] Rhee[40]
	Wrist arthroscopy	Liu[52]
	Trapiezectomy/carpal prosthesis	Müller[53]
	Distal radius fracture	Huang,[54] Ahmad,[55] Tahir[56]
Miscellaneous	Mass excision	Shulman[3]
	Local debridement	Tang[30]
	Foreign body removal	Tang[30]

Hand Trauma Surgery

A unique benefit of WALANT is the ability to conduct intraoperative assessments of repairs.[24,35] Currently, intraoperative assessment of flexor tendon repair is limited to subjective means, highly dependent on operator skill and experience.[35] With a patient unable to perform active movements under regional or general anesthesia, it is difficult to accurately assess tendon gapping, bunching and glide, and their effect on the need for venting of pulleys, which may affect overall function.[57] Excessive pulley venting may lead to tendon bowstringing, whereas underventing may result in reduced glide. Higgins reported a flexor tendon rupture rate of 3.3% through intraoperative assessments to identify and correct gapping or bunching.[34] Woo identified this as a significant advantage of WALANT, allowing the operator to confidently achieve optimal glide and tension before closure.[43]

Revascularization and replantation of amputated digits have also successfully been undertaken using WALANT. A study encompassing five digital revascularizations and eight finger replantations demonstrated good functional outcomes under this technique.[32] However, a temporary digital tourniquet was initially required in three cases to safely identify anatomical structures.[32]

No specific literature on the outcomes of nerve repair under WALANT was found. However, our group has previously published on the high rate of patient satisfaction with WALANT in the context of hand trauma, including those undergoing digital neurosynthesis.[36] The senior author would, however, caution against undertaking surgery for nerve injury proximal to the wrist, as it is often poorly tolerated by patients.

Fixation of bony injuries under WALANT is well documented.[30,44] In a study of 25 patients undergoing metacarpal fracture fixation, positive outcomes (including no loss of reduction, inadequate fixation, malrotation, screw migration, or infection) were achieved.[20] Dynamic intraoperative assessment allows for identification of impingement or improper tendon glide over metalwork, as well as assessment of range of motion, and provides the opportunity for patient education about postoperative care.[54] Distal radius fracture fixation can also be performed under WALANT with good outcomes.[54,55] WALANT expedites surgery by avoiding extensive preoperative workup in older and/or co-morbid patients presenting with distal radius fracture.[56]

Elective Hand Surgery

Elective hand procedures such as carpal tunnel release (CTR)[30,50] and TFR[30] (Table 1) can be performed under WALANT. Ki Lee reported significantly reduced postoperative pain within 24 hours after de Quervain's tenosynovitis (DQT) release and achieved high patient satisfaction.[39] Mohammed reported a series of tendon transfers for leprosy patients under WALANT, providing treatment at significantly reduced cost to a disadvantaged population in India.[33] Trapeziometacarpal joint arthroplasties (TMJA) performed under WALANT have been associated with higher patient satisfaction rates compared to general anesthetic/tourniquet.[53,58] Liu reported the use of ACLA in wide awake wrist arthroscopy, citing the key advantage of intraoperative "grip and release" kinetic testing, particularly beneficial in the dynamic assessment of carpal instability.[52]

Although there is a paucity of high-quality randomized controlled evidence to demonstrate an improvement in functional outcome in elective WALANT-based surgery, there is no evidence to suggest inferiority. A meta-analysis of published data sought to compare outcomes of hand surgeries using WALANT versus intravenous, regional or local anesthesia with tourniquet and found no statistical difference in complication rates.[59] Several other studies have found no difference in operative time between WALANT and LA/TQ groups in CTR, TFR, and DQT release or TMJA.[39,58] One study did find that WALANT resulted in a significant reduction in postoperative pain.[59] Tulipan compared outcomes of CTR under WALANT versus LA/TQ with sedation and found no difference between the groups in postoperative disability, intraoperative pain scores, time to return to work or satisfaction with their method of anesthesia.[45] Sraj reported outcomes of CTR using plain lidocaine versus WALANT and noted an increase in mean operative time of 36% in the plain lidocaine group, thereby highlighting the importance of the vasoconstrictive effect of adrenaline.[46]

NONOPERATIVE BENEFITS OF WALANT

Cost Savings

WALANT minimizes the need for anesthetic staff and associated cost of machinery, along with the requirement for operating theaters. Many hand procedures can be performed safely in minor procedure rooms.[37] Rhee reported an average saving of approximately 85% per procedure, and Kazmers, an 11-fold saving by performing CTRs in a clinic setting under WALANT.[40,50] Van-Demark combined WALANT with minor field sterility to decrease surgical wastage and reduce costs. Amongst 1099 cases, $12,350.32 was saved and 2.8 tonnes of waste reduced.[60] Burns modified their TFR surgery pathway by switching from IV sedation to WALANT administered in the preoperative holding room rather than the operating theater. They found an 18% reduction in cost and an overall reduction in treatment time of 41 minutes per patient.[41] Despite clear reductions in cost, the complex nature of clinician reimbursement, particularly in the US, may reduce the monetary benefit for providers.

In the UK, WALANT has enabled a "one stop wide awake" pathway for a variety hand procedures, resulting in a saving of approximately 25%–50% of the national tariff price and a total saving of £750,000 per 1000 cases,[61] in addition to a reduction of between 30%–45% of theater time. Codding ran a cost analysis showing patients undergoing WALANT spent less time in operating theaters, had shorter operating times, and had speedier postoperative recovery, resulting in financial and other resource savings.[38,62] Wheelcock suggests that direct savings accrue to patients too.[63] Costs and inconvenience shouldered by patients traveling from rural areas to

regional centers are not insignificant; they often need to purchase accommodation or stay overnight following general anesthetic.[63] Specialist hand surgery services are often centralized to regional university teaching hospitals, known as the hub and spoke model of healthcare. We hypothesize that WALANT, coupled with the concept of limited field sterility, could allow the surgeon to overcome this issue by delivering treatment directly in the community.[60,61,64]

Remote working through video conferencing is now possible as a result of the COVID-19 pandemic. In this way, pre- and post-surgical care can be easily delivered to patients. As such, an outreach program can be developed in which patient care is expanded further, local resources utilized, and the financial burden reduced for patients and the healthcare system.

Resource Efficiency

An advantage of WALANT is its utilization in under-resourced environments. During the COVID-19 pandemic, healthcare systems struggled to balance the demand for anesthetists, surgical staff, ventilators and recovery beds with the need to provide elective procedures.[65] This has resulted in increased WALANT surgery uptake through efficiently re-designed treatment pathways. Assessment and operative intervention can occur simultaneously, with minimal staff and equipment requirements[66] and no increase in complications.[64] The British Society for Surgery of the Hand (BSSH) and British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS) provided guidance that all hand injuries be operated on under WALANT to limit patient footfall within hospitals related to general anesthesia requirements.[67] WALANT facilitated "one-stop" clinics are likely to become the new normal[31] with educators calling for its incorporation into the plastic surgery training curriculum.[68]

Rhee highlighted the invaluable utility of WALANT in conflict zones. Austere environments have limited access to anesthetic personnel or equipment. Procedures such as phalangeal and metacarpal fracture fixation, tendon repairs, digital revascularisation and replantation can be performed under WALANT, conserving finite military resources.[32,51] WALANT reduces the need for unnecessary preoperative investigations, which can be costly, lengthy and delay time to operation. One study comparing WALANT to LA/TQ with sedation found that those in the WALANT group spent around 50% less time in postoperative recovery.[69] In addition, 48% of those given LA/TQ + sedation required preoperative investigations including ECGs, blood tests and chest imaging, while only 3% of the WALANT group did.

WALANT surgery minimizes the need for recovery bed, unnecessary perioperative investigations and systemic anesthetic care requirements.[51,69] Lastly, WALANT provides a safe method of operating on complex patients whose co-morbidities would otherwise be a contraindication to general anesthetic.[54,70] The risks of serious postoperative complications associated with general anesthetic such as respiratory failure, infection, and venous thromboembolism are significantly reduced.[71]

Patient Experience

Electively, WALANT has been shown to be comfortable method of anesthesia that is welcomed by patients. A study involving 100 patients undergoing elective hand procedures under ACLA were asked to rate their postoperative levels of anxiety and pain on a visual analogue scale. The authors found that 91% of their respondents rated their intraoperative pain and anxiety as 2 of 10 or less, and 3 of 10 or less, respectively. Additionally, 86% stated they would undergo WALANT surgery again.[72] Similarly, Van-Demark reported high satisfaction ratings amongst his cohort of 111 patients, with 95% relating their experience dentist visit or better, 99% willing to repeat their experience under WALANT again, and 99% willing to recommend it to others.[64] Gunasagaran compared the effect of WALANT with the traditional LA/TQ method on patient comfort during ganglion excision, CTR, and TFR surgery.[26] They reported patients found WALANT more comfortable and preferable with mean visual analogue scale scores of 2.33 and 4.72 ($P < 0.05$), respectively.[26] Nikkhah also found that their patients experienced less pain during CTR with WALANT.[73] However, other researchers have shown no significant difference between the two techniques.[48] In the context of trauma, our team has shown WALANT to be effective, with patient reported comfort similar to the elective setting.[36] WALANT can also improve comfort during the perioperative period. There is no requirement for preoperative fasting or postoperative carer support after general anesthetic.[74] Equally, postoperative nausea and vomiting, which can affect around 30% of patients can also be avoided.[75] Lastly the analgesic effects of WALANT can prevent the need for postoperative opioid analgesics, reducing possible dependency on these narcotic agents.[47,49,76]

CONSIDERATIONS FOR NEW WALANT PRACTITIONERS

Contraindications

ACLAs should not be injected into patients with a documented allergy or into the hands of those with a previous arterial injury or a known vascular insufficiency.[77] Local anesthetic is also known to be less effective in tissues with active infection. Injecting ACLA can be challenging in pediatric, anxious or non-compliant patients. For patients with cardiac disease, the adrenaline concentration can be diluted down to 1:400,000.[77] Operating time under WALANT is limited by duration of anesthesia, vasoconstriction, and patient comfort. The former two factors can be extended by intraoperative "top-up" injections of ACLA. To address patient comfort, case selection is key; the authors limit WALANT to a maximum of 2 hours of expected operating time and do not offer this to patients who indicate high levels of anxiety about awake surgery.[78] In addition, there is a theoretical risk of inducing sickling in patients with sickle cell disease; however, no data are available to guide the practitioner in such cases.[79] Lastly, the operator should be prepared for the unlikely event of failure of anesthesia, which may require abandonment

of procedure or conversion to traditional anesthetic techniques; there is, however, no literature on incidence of such events.

Misconceptions around WALANT Use

The most notable barrier to uptake of WALANT is the perception that injecting adrenaline into the extremity will cause ischemic necrosis. However, there is now ample literature, including those with large patient cohorts[8,80] much of which has been discussed in earlier sections of this paper, to show these concerns are without merit. Digital necrosis has now largely been attributed to the historic use of procaine rather than the effects of adrenaline.[12,13] Appropriate surgeon education can help overcome this taboo. With the rising popularity of WALANT, it is vital that its safety profile is discussed more amongst colleagues.

A second barrier is the efficacy of adrenaline in achieving a safe and bloodless operating field, especially in procedures with minimal working space such as CTR or TFR. As has been highlighted in this review, sufficient data exists to show that WALANT affords a satisfactory operating field, with no significant effect on operating time, blood loss or complications. The caveat to this is that the surgeon must allow sufficient time for the ACLA to "cook," or produce its hemostatic effect. This requires the surgeon to adapt their management of operating lists and operating theater efficiency. We would advise that the surgeon, or a competent assistant, inject the ACLA in a holding room before or during the preceding case to help manage patient flow in the operating room.

A third barrier is operator unfamiliarity with the wide spectrum of hand procedures that can be performed safely under WALANT in both the trauma and elective settings (Table 1). Historical dogma and relatively recent adoption of ACLA in the hand may hinder its routine uptake over traditional methods; however, this review provides strong evidence for its safety, efficacy, versatility, cost effectiveness and patient satisfaction to overcome this. These advantages should be communicated through further research, conference presentations, and colleague discussions. Ultimately, this benefits all stakeholders including patients, surgeons, and healthcare systems.

CONCLUSIONS

WALANT is increasing in popularity following the acceptance of the safety of adrenaline in the extremity. Our review clearly outlines the benefits of this technique with regard to expedited and safe patient care, cost saving, resource allocation, and intraoperative assessment compared with conventional techniques. In the current international climate of spiraling healthcare costs and finite resources, WALANT provides an excellent opportunity to redesign and optimize surgical pathways toward providing safe and efficient surgery in the hand and wrist. We believe our review provides clear precedence for utilizing WALANT and hope it will inform surgeons beginning their practice with it.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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