

Cohort Study

Treatment of hand infections using WALANT -when the anesthesiologist is not available: A retrospective cohort study



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ABSTRACT

Background: The aim of this study was to determine, if Wide Awake Local Anesthesia No Tourniquet (WALANT) can be used as an alternative method of providing anesthesia in management of deep infections of the hand. Since the advent of WALANT in 2003, infections of the hand have been regarded as a contraindication to its use. Occasional shortage of anesthesiologic manpower, especially during busy call hours and the current COVID-19 pandemic can lead to delay of treatment where urgent surgery is needed, to prevent progress of an infection, that can result in severe morbidity.

Methods: In the period from 2015 to 2020, 16 patients with various infections of the hand underwent 17 operations using WALANT in a Hand Trauma and Replantation Center (HTRC) in Germany. Retrospective cohort analysis of their operation reports, with emphasis on location of infection, time and duration of the operation, intraoperative incidents and complications were carried out. We also evaluated the need for revision surgery or necessity to convert to general anesthesia and factors causing delay till the time of surgery.

Results: No case of inadequate analgesia, the need to convert to general anesthesia, ischemic events or cardiovascular complications with the use of the WALANT solution containing adrenaline and lidocaine in the treatment of deep tissue infections.

The highest priority of limb preservation was ensured as no patient progressed to amputation of a digit or the hand. There was a statistically significant difference ($p \leq 0.01$) in delay from the time of admission until surgery of up to 9h24 m (SD±3h34 m) during the week and 4h10 m (SD±2h28 m) during the weekend.

Conclusion: The status of infection as an absolute contraindication to the use of WALANT should be revised. Especially when human resources are limited, WALANT is an adequate technique to enable quick anesthesia for urgent treatment to prevent progression of hand infections.

1. Introduction

Most surgeons opting for an operation have probably been faced with the challenge of shortage of anesthesiologic manpower. Most commonly during busy call hours, but also as a result of limited human resources and the ongoing COVID-19 pandemic, hence delay in the treatment of patients can occur. To preserve function of the hand and prevent further morbidity and permanent disability, acute infections of the hand require timely initiation of surgical treatment [1]. This is a basic principle of hand surgery and well documented in the literature [1].

Wide Awake Local Anesthesia No Tourniquet (WALANT) is a globally established technique to provide qualitative surgical care to the diseased

hand. Numerous publications and the groundbreaking book “Wide Awake Hand Surgery” by LaLonde have contributed to the widespread and increasing number of elective and emergency surgeries performed using the WALANT technique [2]. However, there is a paucity of data regarding the use of this technique in the treatment of deep hand infections.

WALANT is a form of anesthesia, which enables the surgeon to operate on conscious patients by injection of an anesthetic solution containing lidocaine and adrenaline [2,3]. The additive adrenaline produces a bloodless operative site via its vasoconstrictive effect, thereby allowing the procedure to be performed without the use of a tourniquet [3,4]. This vasoconstrictive effect further serves to prolong

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the effect of the local anesthetic agent [4].

Benefits of operating without a tourniquet include reduced risk of permanent damage due to pressure to the skin, underlying soft tissue and neurovascular structures [5]. Further, agonizing discomfort for the conscious patients at the site of the tourniquet or cardiovascular complications associated with its use no longer have to be considered during surgery [6,7].

In numerous publications the use of WALANT or local anesthesia in hand infections is stated as a relative or absolute contraindication [8–11]. Explanations brought forward suggest that efficacy of the tumescence technique is reduced when inflammation is present, as local anesthetics are weak bases and will undergo ionization when the surgical site is acidic as seen in tissue infections [10]. In our center we have been able to use tumescence anesthesia in selected cases in the treatment of deep tissue infections of the hand over a period of 6 years, when urgent surgical therapy was needed however anesthetic support was not available.

The purpose of this study was to determine, if WALANT can be used as an alternative method to provide anesthesia in the management of deep tissue infections. This retrospective study describes our experiences in the treatment of deep tissue infections of the hand using the WALANT technique as an alternative to general anesthesia in a Hand Trauma and Replantation Center (HTRC) in Germany over a six-year period.

2. Materials and methods

2.1. Data collection

From May 2015 to August 2020 16 patients with various infections of the hand undergoing 17 operations using WALANT technique were identified via the Hospital Information System SAP (SAP SE, Waldorf, Germany). We performed a retrospective cohort analysis of these patients and their surgical reports with emphasis on location of the infection, time of presentation, time till surgery and duration of operative treatment as well as intraoperative incidents and complications. We particularly evaluated the need for revision surgery and necessity to convert to general anesthesia. In addition to demographics and the aforementioned data collected, we included cause of the injury, bacterial contamination, antibiotic treatment, radiological images, comorbidities, laboratory values and histopathologic findings. Inclusion criteria was WALANT-technique in the treatment of hand infections. Exclusion criteria were the ab initio use of a tourniquet, regional or general anesthesia.

All patients were treated in a Department of Plastic, Aesthetic, Hand and Reconstructive Surgery in a Hand Trauma and Replantation Center (HTRC) in Germany. Approval was obtained from the Institutional Ethics Board (No.9662_BO_K_2021).

2.2. Surgeries

Preoperatively, informed consent was obtained from all patients. The decision to use WALANT was taken by the operating surgeons. However, the option to choose an alternative technique of anesthesia was offered to all patients. All patients were operated in standard operating theaters. Further, intravenous access was cited and basic monitoring of their vital signs, blood pressure and oxygen saturation was established. The WALANT solution used in our institution is prepared by mixing 20 ml of 2% lidocaine, with 0,4 ml 1:1000 (1 mg/ml) adrenaline in addition to 20 ml of 0,9% normal saline as described by Barros [2,12]. The WALANT solution was administered by the operating surgeon.

2.3. Post-operative management

Following surgery, the need for intravenous antibiotics or a possible second look surgery were the main determining factors for the admission

to the surgical ward. Otherwise, the patients were discharged with splinting, instructions to arm elevation and oral antibiotics. Provided that there was no contraindication to the use of NSAIDs, we routinely prescribe Ibuprofen to all patients for its analgesic and anti-inflammatory properties.

2.4. Statistical analysis

Descriptive statistics were reported as numbers and percentages or as mean, standard deviation and range of data. A student t-test was used to determine if there were differences in the duration from the time of admission to the time of surgery. A p-value < 0.05 was considered as statistically significant. Because the sample size was predetermined by the number of patients that were operated, no a-priori sample size calculation was performed.

All analyses were performed using Microsoft® Excel Version 16.47.1 and Prism Version 9.0.2 (134), February 10, 2021.

The study was reported in line with the STROCSS criteria [13].

3. Results

In this study 16 patients (9 male and 7 female) undergoing 17 operations were included. Patient age ranged from 18 to 88 years with a mean age of 43.4 years (SD±19.4). In 15 cases (88%) an initial trauma was the cause for a secondary infection. Etiologically cuts or penetrating injuries accounted for 41%, while animal bites for 35% (Table 1).

Locations of infection within the hand are summarized in Table 1 and Fig. 4 (see Fig. 3) (see Fig. 2).

Regarding the associated comorbidities, three patients had diabetes mellitus, one receiving additional oral steroids for keratosis pilaris. There was one smoker. None of the aforementioned patients required revision surgery.

Using conventional radiography, a radiopaque foreign body was identified as the cause of the infection in one patient.

The mean onset of symptoms was 2.4 days (SD ± 1.8) prior to presentation. While we were the first medical contact for 44% of the patients, the remaining 56% had received some form of medical treatment prior to referral to our clinic.

All patients were operated during on-call-hours during weekdays or at the weekend. Mean time of presentation from Monday to Friday was 12:27pm and 1:52pm on the weekends.

The mean onset of surgery was at 6:21pm (Table 2).

During the week the mean time from first presentation at accident and emergency department (A/E) to surgery was 9h24 m (SD±3h34 m). On the weekends this time reduced to 4h10 m (SD±2h28 m) (p<0.01) (Table 3/Fig. 1).

The mean duration of surgery was 28 min (SD ± 19.3), with the longest operation lasting 70 min.

An average of 15.3 ml (SD ± 5.5) of WALANT solution was injected. In all cases, the affected extremity was postoperatively splinted. Consultant surgeons carried out 53% of the operations, while 47% were performed by surgical residents under supervision.

Table 1
Location and etiology of the infection.

Location of Infection	Total	Percentages
Thumb	2	12%
Index or Middle finger	5	29%
Palm of the hand	3	18%
Dorsum of the hand	5	29%
Infection of a digit spreading to the hand	2	12%
Etiology of Infection		
Animal bite	6	35%
Cut and penetration injuries	7	41%
Post-surgical infections	2	12%
Unknown to patient	2	12%

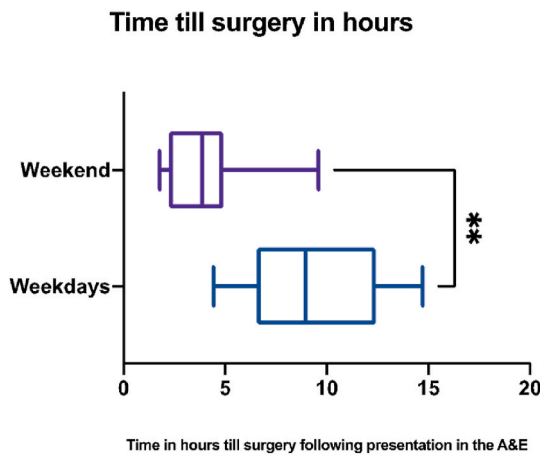


Fig. 1. Differences in delay till surgery on weekends vs. weekdays following presentation at the A&E $p < 0.01$

Fig. 1 Deep tissue infection treated in WALANT after delayed presentation following a chainsaw injury.

Culture and sensitivity testing from the surgical sites obtained in 88% ($n = 15$) of surgeries resulted in bacterial growth in all but one wound swab obtained (Table 4). Polymicrobial growth (≥ 2) was documented in 33.3% of cases. Intravenous perioperative antibiotic treatment was commenced in 10 patients. All patients continued oral antibiotics following discharge.

All patients had a preoperative laboratory work-up. The mean C-reactive protein (CRP) was 9.5 mg/dl ($SD \pm 9.0$), (Reference CRP < 5 mg/l). Leukocyte mean count was $9.5 \times 10^3/\mu\text{l}$ ($SD \pm 3.3$). On the first postoperative day, the mean CRP ($n = 8$) has risen to 23.1 ($SD \pm 15.1$ mg/l), while the leukocyte count has fallen to $6.9 \times 10^3/\mu\text{l}$ ($SD \pm 3.2$).

Post-surgical admission rate was 59%, with a mean stay of 2.3 days (range 0–10 days), while the remaining patients were treated as outpatients.

Two patients had scheduled 2nd look operations one in WALANT technique while the other was carried out in general anesthesia. Another two patients required unscheduled revision surgery because of persistent infection.

Intraoperative incidences included a panic attack in one patient. In a second patient we had to temporarily place a finger tourniquet due to bleeding at the operation site. All other procedures were performed without documented intraoperative incidences or difficulties performing the surgery without tourniquet.

Furthermore, there was no documented case of inadequate analgesia

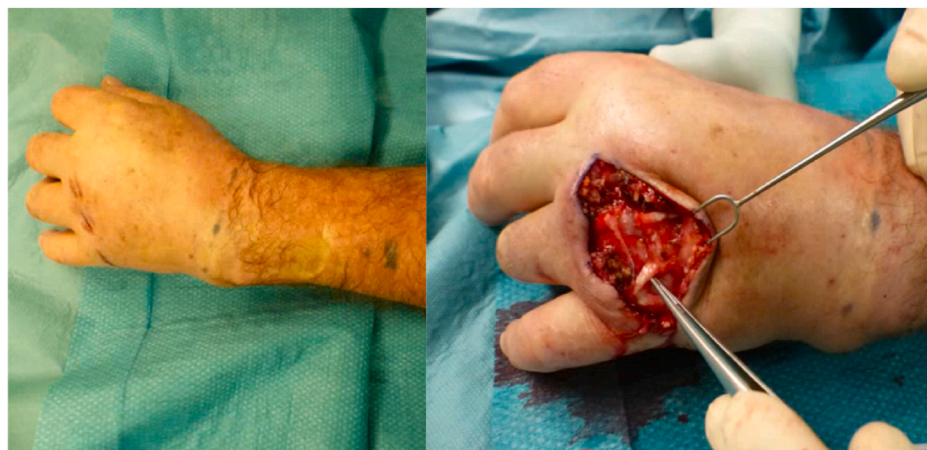


Fig. 2. Deep tissue infection treated in WALANT after delayed presentation following a chainsaw injury.

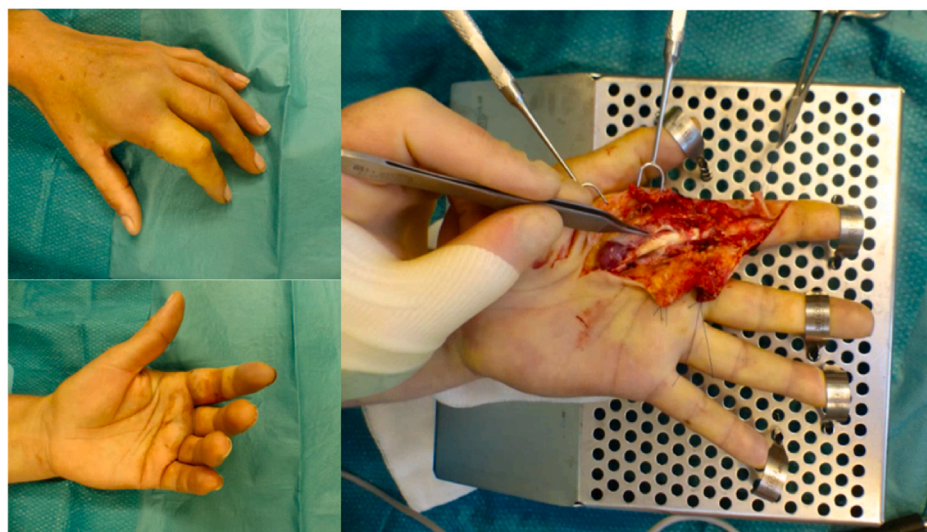


Fig. 3. Deep palmar infection of the hand following injury with kitchen knife.

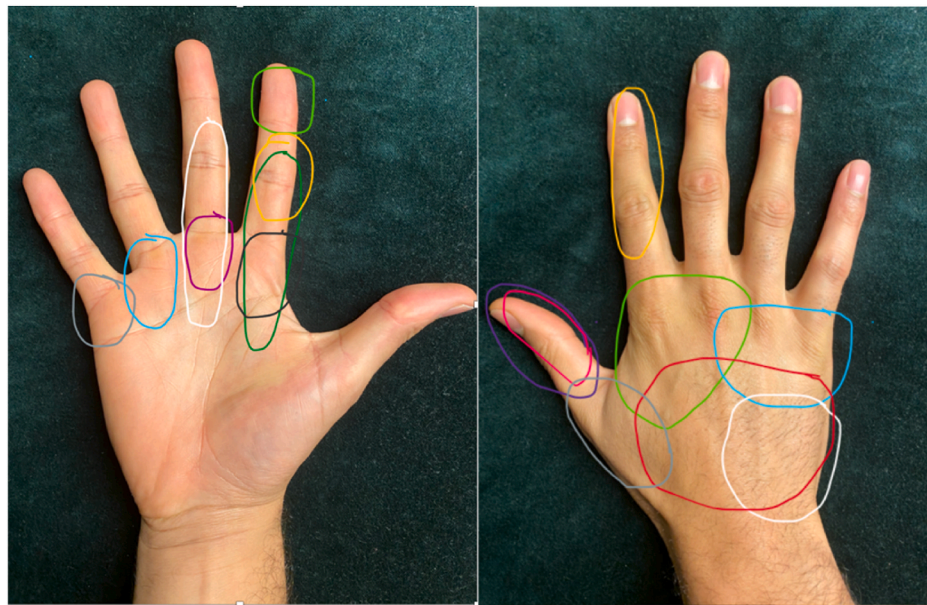


Fig. 4. Showing the sites of the infections.

Table 2

Mean time of arrival, mean time of surgery and time until surgery in hours following arrival at the A/E.

	Mean time of arrival	SD	Mean time of surgery	SD	Mean time till surgery following arrival	SD
All	12:59pm	±4h3m	6:21pm	±5h23 m	6h47 m	±4h
Weekdays n = 8	11:22am	±3h46 m	5:46pm	±7h5m	9h24 m	±3h34 m
Weekend n = 8	2:36pm	±3h52 m	6:47pm	±3h53 m	4h10 m	±2h28 m

One patient was on admission for a dermatological illness so he is not represented in the table.

Table 3

Comparison of time till surgery on weekends vs. weekdays showing the delay till surgery.

Time till surgery in hours	Weekends	Weekdays	p-value
Mean ± SD	4h10m±2h28 m	9h24 m ± 3h34 m	p<0.01

Statistically significant (p < 0.05).

Table 4

Table of microorganisms detected in swab cultures (n = 15)

Name of bacteria identified	n (%)
Gram-positive	
<i>Staphylococcus aureus</i>	5 (33.3)
<i>Staphylococcus lugdunensis</i>	2 (13.3)
<i>Staphylococcus capitis</i>	2 (13.3)
<i>Staphylococcus epidermidis</i>	1 (6.7)
<i>Staphylococcus warneri</i>	1 (6.7)
<i>Staphylococcus hominis</i>	1 (6.7)
Gram-negative	
<i>Pasteurella canis</i>	2 (13.3)
<i>Pasteurella multocida</i>	5 (33.3)
<i>Neisseria weaveri</i>	1 (6.7)
<i>Escherichia coli</i>	1 (6.7)
No bacterial growth	1 (6.7)

The patient with no growth was previously placed on antibiotics by his general practitioner.

More than 1 bacterium was identified in 5 patients.

Gram negative growth was mostly associated with animal bites.

or the need for converting to general anesthesia during surgery. Likewise, the injection of WALANT solution containing adrenaline and lidocaine resulted in no cardiovascular complications or ischemic events. There was a single case of post-surgical flexor tendon adhesions. None of the patients required subsequent amputation.

With regards to the post-operative management following the operation, 5 patients could immediately be discharged into outpatient care with a written recommendation to the general practitioner or hand surgeon in private practice.

The patients were discharged on non-opioid analgesics with 3 receiving a combination of Ibuprofen (600 mg three times a day) with Metamizole or Paracetamol (1000 mg four times a day).

One patient presented to our clinic with secondary flexor tendon adhesions of a digit which we subsequently operatively addressed 5 months after the initial surgery.

Hence based on our medical records we can presume that the other patients suffered no complications till date.

4. Discussion

With the ongoing COVID-19 pandemic and the immense strain on the health system, access to anesthetic support and ventilators has been put to the test globally [11,14,15]. This has resulted in change of how elective and emergency hand surgery had to be performed, making alternatives like tumescent anesthesia sought after [14].

In separate letters, Hamilton et al. [14] and Nikkhah, M.D [16], respectively, described witnessing an increase in the use of WALANT for treatment of surgical emergencies of the hand [14,16].

The British Society for Surgery of the Hand put forward the “Wide Awake Hand Surgery Handbook”, stating, that WALANT not only allows for the continued treatment of patients with hand and wrist injuries, but

also reduces risk to caregivers by not generating aerosols that would otherwise put the surgeon and other caregivers at risk [11].

Our clinic being one of the largest tertiary referral hospitals in the north of Germany, we experienced in the 1st wave of COVID-19 in 2020 a reallocation of ventilator capacities and manpower from surgical theater to the intensive care units in preparation for a surge in coronavirus cases as was observed in other parts of Europe.

Having WALANT as an alternative to treat patients with hand infections that would otherwise require general anesthesia, offers some form of comfort to both patients and surgeons in exceptional situations like the COVID-19 pandemic. Furthermore, WALANT can and has been used successfully in limited resource settings such as military medicine and developing countries [17,18].

Therefore, we wish to describe our approach and experiences in treating hand infections with the above-mentioned method.

As demonstrated by the patients' wide range of age (18–88 years), WALANT has shown itself applicable for patients of all ages. Pregnancy, a period where maternal and fetal wellbeing have to be considered, in non-elective surgeries the use of local anesthetics with adrenaline has been deemed safe [19]. Weighing risks of general anesthesia against the benefits of the less invasive WALANT technique we performed and second look operations at 33 weeks of gestation without intraoperative occurrences.

However, we do recognize that proper patient selection is important. Not all patients can be treated in tumescence anesthesia. Absolute contraindications include a known, hypersensitivity to lidocaine or adrenaline, a bleeding diathesis, non-cooperative patients, pediatric patients and patients with peripheral vascular disease [4,11,20].

In elective ambulant operations because patients are known to the surgeon and those with relevant comorbidities can be screened out and referred may need there is no requirement for monitoring or an intravenous access [2]. In contrast we usually have first contact with the patient on the day of surgery in the A&E.

In the case of an emergency the operation cannot be postponed. Therefore, for safety a peripheral intravenous access is established and all patients are placed on a monitor to keep track of their vital signs during the course of the surgery. This is also done precautionary for the eventuality of complications.

Because we use WALANT in a wide variety of elective surgeries, there was no need for further training in the application of the WALANT solution as the technical principles are the same for elective cases and emergency surgeries.

It is important to note that we avoid injecting the solution directly into infected tissue, in order to prevent iatrogenic dispersion of the infection [21].

We rather use a technique of inject the solution circumferentially around the affected region starting proximally [2].

In our study we had one case of moderate bleeding during the course of the operation. To secure hemostasis from a bleeding vessel, we applied a temporary finger tourniquet.

A tourniquet can hence serve as a fallback option in cases of profuse bleeding, if for example a blood vessel is severed.

In a randomized control trial comparing wide awake anesthesia to general anesthesia Hamid et al. ²⁰ found that there is no significant difference in the level of preoperative anxiety between WALANT and general anesthesia [22]. In our study one surgery had to be temporarily paused, as the patient experienced a panic attack due to anxiety. However, as described by Lalonde with simple reassurance we were able to calm the patient down, resume and eventually complete the surgery without any further interruptions [2].

In all other procedures no further difficulties were documented and none of the patients needed conversion to general anesthesia or administration of additional intravenous sedatives or pain medications. Similar results were reported in a study using WALANT in treating distal radius fractures [22].

Another advantage is that WALANT technique can be used by

surgeons with varying levels of experience. In the present study the level of experience of the operating surgeon varied from Level I to III with reference to the categories suggested by Tang 2009 for reporting surgical experience (I = non-specialist, II = less experienced and III = experienced specialist) [23]. However, as our center is a teaching hospital, we guarantee a high standard of care by instructional assistance of our surgeons in training.

Dastagir et al. postulated in a previous study about hand infections, that late presentation to a hand surgeon not only leads to a longer hospital stay and increased number of operations, but may also lead to more complications [24]. Considering the fact that 56% of the study's participants already received previous treatment, with a mean onset of symptoms 2.4 days prior to presentation. The need to render expert surgical treatment on the day of first contact cannot be over emphasized in order to prevent further progression, resultant morbidity, loss of function and in some cases permanent disability [25].

Our data demonstrated that the time period from presentation to the A&E until patients are eventually operated accounts for a further in hospital delay (Table 2).

There was a statistically significant longer in-hospital delay during the week from the time of presentation till surgery as compared to weekends (Table 3). Numerous factors contribute to this difference. The most considerable being pre-scheduled elective operations within the week.

However, as hand surgeons being fully aware of complications that could arise following delayed treatment, we strongly advocate that the decision to operate in WALANT should be taken primarily or latest as soon as it becomes eminent that timely anesthetic support will not be available as "time is function" in severe hand infections.

We recognize that intraoperative difficulties can occur with the use of WALANT. For example, reassuring an anxious patient might simply not work in some cases and the surgery will eventually have to be stopped and postponed till the time that anesthetic support is available.

Hence, we do not challenge the place of the anesthetist in the management of hand infections and we cannot overemphasize their importance in our daily practice. However, through proper history taking, patients that might not tolerate the operation in WALANT or have other contraindications to its use can be screened out right at the time of presentation in the A&E.

Another benefit of the WALANT technique is its cost effectiveness [7, 17,26,27]. As no anesthesiologist is needed, there is a resultant reduction in overall cost to the health system and to patients in low and middle-income countries where medical services are often still being paid out-of-pocket by those receiving health care [17,26–28].

One of the major limitations of our study is the small sample size and retrospective study design. However, for COVID-19 pandemic reason demonstrating the need for alternative treatment options in the case of limited resources our study should serve as a pilot study and should be made public. As to the best of our knowledge no similar study has been published yet.

Secondly, we are well aware that plexus anesthesia which could serve as a control group is performed in some clinics by the operating surgeon. However, this does not take away the tourniquet pain and the risk of other plexus anesthesia related complications.

The utmost goal of limb preservation was ensured as no patient progressed to amputation of a digit or the hand reported in literature with varying rates of up to 20% depending on underlying etiology of the infection and presence of comorbidities [29–31].

Therefore, especially when human resources are limited WALANT can and should serve as a viable means of enabling quick and quality treatment to patients, in order to prevent the progression of infection with increased morbidity and mortality of the hand and patient as "time is function".

5. Conclusion

This study gives an inside into the emergency treatment of deep tissue infections of the hand using Wide Awake Local Anesthesia No Tourniquet.

There was no case of inadequate analgesia, the need to convert to general anesthesia or cardiovascular complications with the use of the WALANT solution containing Adrenaline and Lidocaine in the treatment of deep tissue infections of the hand.

We therefore recommend that the status of a deep infection of the hand being an absolute contraindication to the use of WALANT should be reevaluated.

Ethical approval

Approval was obtained from the Ethic Board of the Hannover Medical School (MHH) Germany.

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Author contribution

A. Enechukwu MD¹: Writing -Original Draft, Formal analysis, Writing-Review & Editing, Project administration. F. Bucher MD¹: Writing-Review & Editing. K. Dastagir MD¹: Formal analysis, Writing-Review & Editing. A. Jokuszies MD, PHD¹: Resources, Writing-Review & Editing. P. Vogt MD, PHD¹: Conceptualization, Methodology. S. Könniker MD, PHD¹: Conceptualization, Methodology, Supervision, Writing- Review & Editing. ¹Department of Plastic, Aesthetic, Hand and Reconstructive Surgery, Hannover Medical School, Hannover, Germany.

Trial registry number

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https://www.drks.de/drks_web/navigate.do?navigationId=trial.HTML&TRIAL_ID=DRKS00025704

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Consent

Full approval from the ethics committee was obtained and subjects gave informed consent.

Declarations of interest

None.

Provenance and peer review

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Declaration of competing interest

None.

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Appendix A. Supplementary data

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