13 years of hand surgery without an anesthesiologist. An analysis of efficacy and safety of presurgical anesthesia as delivered by surgeons without the assistance of anesthesiologists

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ABSTRACT:
Introduction: The assistance of anaesthesiologist is considered an inseparable part of most surgical procedures, with the exception of a small proportion of minor procedures performed under local anaesthesia. In hand surgery, a vast majority of procedures, even those lasting several hours, can be carried out under regional (brachial plexus block) or local (infiltration) anaesthesia. These can be delivered by the surgeons themselves, allowing the surgeries to be carried out without the assistance of anesthesiologists.

Aim: The aim of this study was to analyze the efficacy and safety of presurgical anesthesia as delivered by surgeons without the assistance of anesthesiologists in the course of hand surgery procedures performed within the institution headed by the author of this article.

Material and methods: The analysis was based on the records of anesthesia protocols filled out by the surgeons who delivered the anesthesia and who operated on the patients. The variables considered included the efficacy of anesthesia and the anesthesia-related adverse effects and complications.

Results: Over a period of 13 years (2010–2022), a total of 24,703 surgeries were delivered; of these, 22,228 (91%) surgeries were carried out without anesthesiologists, with anesthesia being delivered by the surgeon him/herself. The efficacy of these procedures (local anaesthesia and brachial plexus blocks combined) was 99%. A total of 631 (2.8%) anesthesia-related adverse reactions were recorded, most of them being transient, requiring immediate interventions and not leading to any serious sequelae. In only 17 cases (0.07%), adverse effects resulted in cancellation and rescheduling of the elective surgery.

Conclusions: Pre-surgical anesthesia as delivered prior to hand surgery procedures by the surgeons without the assistance of anesthesiologists is effective and safe while being associated with numerous benefits for patients, surgeons and the health care system's budget.

KEYWORDS: brachial plexus block, hand surgery, regional anesthesia, WALANT anesthesia

ABBREVIATIONS
ECG – electrocardiogram
NOACs – novel oral anticoagulants
WALANT – wide-awake local anesthesia with no tourniquet

INTRODUCTION
The assistance of anaesthesiologist is considered an inseparable part of most surgical procedures, with the exception of a small proportion of minor procedures performed under local anaesthesia delivered by the surgeon him/herself. In the specific field of hand surgery, the vast majority of operations, even those lasting several hours, can be performed under regional anaesthesia (brachial plexus block); for the past 10 years or so, many minor and medium-extent surgeries have also been performed under local anaesthesia with lignocaine-adrenaline solution, making it possible to perform the procedure without the use of a tourniquet cuff to achieve bloodless surgical field [1–3]. This type of anaesthesia is referred to as WALANT (wide-awake local anesthesia with no tourniquet) and widely used in hand surgery today. Having undergone proper training and acquired relevant proficiency, a surgeon is able to deliver local (infiltration) anesthesia, as well as regional (brachial plexus block) anesthesia, making it possible for the surgery to proceed without the involvement of an anesthesiologist (Fig. 1.). At the clinic headed by the author of this article, presurgical anesthesia prior to hand surgery procedures is in a vast majority of cases delivered by the surgeons themselves or resident physicians receiving postgraduate training in surgery [4]. Surgeries are performed within the operating theater without the involvement of an anesthesiologist or nurse anesthetist. Some surgeries are also performed at the surgical ward, within a properly equipped treatment room, with the participation of a dressing nurse.

A brief history of anesthesia being delivered by surgeons at the author’s clinic
The so-called „minor hand surgery” procedures, such as excision of small and superficially located nodules along the digits and metacarpals, suturing of single finger extensor tendon injuries, or the trigger finger release were performed under local (infiltration) anesthesia with lignocaine since the 1990s. Larger surgeries demanded a bloodless surgical field with a tourniquet cuff being placed on the arm, requiring
within the operating theater. Usually, a period of about 30–40 minutes was required between the patient’s arrival at the theater and the start of the procedure due to the requirements related to the preparation and delivery of anesthesia. This significantly reduced the number of elective surgeries and delayed emergency procedures. Facing this problem, the surgeons started to learn to deliver regional anesthesia by themselves. The training was carried out in an informal fashion, with surgeons first assisting the anesthesiologists as they delivered the anesthesia, and then delivering anesthesia themselves under anesthesiologists’ supervision. Originally, brachial plexus anesthesia was delivered from axillary access, using the “paresthesia-guided” technique, without the aid of ultrasound imaging. Having learned this technique, the surgeons delivered regional anesthesia prior to all surgeries. In 2010, the clinic received an ultrasound machine scanner featuring a 12-MHz transducer, and most doctors have learned (on their own, with the help of textbooks and online applications) to deliver brachial plexus blocks under the guidance of ultrasound to improve the anesthesia procedure itself as well as its effectiveness. Precise identification of the elements of the plexus and the ability to administer the anesthetic solution precisely into the area of nerve trunks resulted in virtual elimination of cases of incomplete anesthesia being delivered to the limb and requiring additional injections of lignocaine into the operated area or the use of a tourniquet cuff.

**AIM**

The aim of this study was to analyze the efficacy and safety of presurgical anesthesia as delivered by surgeons without the assistance of anesthesiologists in the course of hand surgery procedures performed within the institution headed by the author of this article.

**MATERIAL AND METHODS**

Between 2010 and 2022, an average of 1900 patients were operated on each year at the authors’ clinic; in this number, an average of 1700 procedures consisted in hand surgeries with regional anesthesia (brachial plexus block), local infiltration anesthesia, or epinephrine infiltration (WALANT). All surgeries were carried out without the participation of an anesthesiologist. The analysis was based on the records of anesthesia protocols filled out by the surgeons who delivered the anesthesia and who operated on the patients. The standard protocol was filled out by the physician delivering anesthesia and then completed by the operator. In about one half of the cases, anesthesia was provided by the surgeon who then performed the surgery. No biochemical, imaging or ECG tests were routinely carried out before anesthesia and surgery. Only patients reporting on a history of coagulation disorders had their blood drawn and coagulation parameters tested. Patients continuously receiving oral anticoagulants (acenocoumarol and warfarin) or novel oral anticoagulants (NOACs) were advised to discontinue therapy 5 days prior to admission to hospital, with low-molecular-weight heparins to be taken as substitutes.

**Brachial plexus block anesthesia**

Anesthesia was performed within the operating room of the surgical department, under ultrasound guidance and with an assistance of a nurse. A standard mixture of 10 mL of 0.5% bupivacaine and...
10 mL of 2% lignocaine was administered (Fig. 2.). Following identification of the elements of the brachial plexus within the axillary fossa on the ultrasound image, a needle was driven into the area of each of the median, ulnar, and radial nerves and, following aspiration with a syringe (to ensure that the needle was not located within a vessel), about 6 mL of the drug mixture was injected into the immediate vicinity of the nerve trunks. The patient reported experiencing characteristic paresthesias within the fingers innervated by each of the targeted nerves. At the end of the procedure, the limb was usually already partially inert. In some cases, when the surgery was planned to last longer than average, or when anesthesia was to be extended to the period after the surgery (for the patient’s comfort), 0.1 g of prostigmine was added to the mixture.

**WALANT anesthesia**

Depending on the type of surgery planned, 10–20 mL of a solution consisting of 2% lignocaine, epinephrine at dilution of 1:100,000, and sodium bicarbonate buffer was injected. The solution was made immediately before administration using the previously prepared substances at the appropriate dilution. For each surgery, the solution was injected into different sites. The anesthetic solution was administered only subcutaneously, with the areas of nerves and neurovascular bundles being avoided (Fig. 4.).

Anesthesia protocols and medical records of patients operated on in the last 13 years (2010–2022) following anesthesia being delivered by surgeons without the participation of anesthesiologists were analyzed in the study. The analyzed variables included the adverse events recorded during anesthesia, surgery and in the postoperative period, as well as anesthesia-related complications.

**RESULTS**

During the study period, a total of 24,703 surgeries were delivered; of these, 22,228 (91%) surgeries were carried out without anesthesiologists. The age of anesthetized patients ranged from 18 to 93 years. The numbers of surgeries performed each year are given in Tab. I.

Tab. II. Types of surgeries performed without anesthesiologists.

<table>
<thead>
<tr>
<th>ELECTIVE SURGERIES</th>
<th>TRAUMA SURGERIES</th>
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<tbody>
<tr>
<td>Carpal tunnel syndrome</td>
<td>Hand and forearm bone fractures</td>
</tr>
<tr>
<td>Dupuytren’s contracture</td>
<td>Tendon injuries</td>
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<tr>
<td>Ganglion</td>
<td>Nerve injuries (Fig. 3A–C)</td>
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<td>Tumors of the upper limb</td>
<td>Complex hand injuries</td>
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<tr>
<td>Cubital tunnel syndrome</td>
<td>Finger replantations (including thumbs)</td>
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<td>Osteoarthritis of the first carpometacarpal (CMC 1) joint (trapeziectomy)</td>
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<td>Trigger finger release</td>
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<tr>
<td>Wrist instability</td>
<td></td>
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<tr>
<td>Tendon transfers in irreversible nerve damage</td>
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<tr>
<td>Arthroscopic wrist surgery</td>
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General and epidural anesthesia was delivered by anesthesiologists primarily prior to general surgeries, both elective (cholecystectomies, abdominal hernia repairs, lower limb varicose veins) and emergency (gastrointestinal obstructions and perforations, appendectomies, incarcerated hernia release and abdominal trauma surgeries in multi-organ trauma). A small percentage of procedures preceded by anesthesia being delivered by an anesthesiologist involved “major” hand injuries (extensive lacerations, replantations) or “major” hand reconstructions, when sural nerve or iliac crest bone harvesting was required for grafting. Nearly all hand surgery operations, both elective and emergency, were carried out under brachial plexus block, WALANT or local (infiltration) anesthesia as delivered by the surgeon without the assistance of an anesthesiologist. The types of these most commonly performed surgeries are listed in Tab. II.

**Effectiveness of anesthesia**

The anesthesia success rate (for infiltration anesthesia and brachial plexus block in total) was 99%. Any additional local anesthesia required during the surgery and any cases of pain in the limb being reported by the patient due to ischemia (in cases of bloodless field surgeries with the use of tourniquet cuffs) were recorded in anesthesia record forms. Additional injections of lignocaine solution into the operated site were required by 217 patients (1%), and tourniquet-induced pain was reported by 314 patients (1.4%). In cases of pain at the operative site, additional anesthesia facilitated the completion of surgery without any further problems. The tourniquet opioid was due to inadequate anesthesia of all brachial plexus nerves; these cases can be considered as cases of anesthesia not being fully effective. Patients usually began to feel discomfort about 30–60 minutes after the tourniquet cuff was inflated, and the severity of the pain increased rapidly, forcing the operator to release the compression and complete the procedure in bloody surgical field. This did not result in any major problems except less comfort for the operator. No case of a procedure being interrupted for this reason was recorded, nor was there any instance of anesthesiologist’s assistance being requested.

**Adverse event rates**

Anesthesia-related adverse events were defined as brief (up to 30 min) feeling unwell with no physical symptoms following the administration of anesthesia, systolic blood pressure being elevated to > 180 mmHg, systolic blood pressure dropping to < 90 mmHg, bradycardia of < 60 bpm and syncope. A total of 631 cases (2.8%) of anesthesia-related adverse events were reported, the vast majority of them being transient, requiring immediate intervention (prolonged monitoring, delayed surgery, administration of antihypertensive drugs, fluid transfusion), and not leading to any serious sequelae (Tab. III.).

The term “feeling unwell” referred to the condition experienced immediately after anesthesia or during the surgery. It was recorded on the basis of the patient’s account, with patients reporting complaints that were difficult to specify and described as just “feeling unwell”. This included feelings of dizziness, nausea, headache, minor shortness of breath, and tightness in the chest. No medical attention was required to any of the cases resulting in the adverse event being categorized as “feeling unwell”, with patients declaring feeling well enough to start or continue with the surgery.
unpleasant paresthesias (numbness and tingling) in the hand were recorded after brachial plexus block and considered to be anesthesia-related. Patients with paresthesias were monitored at the institutional outpatient surgery clinic. In 12 of these patients, paresthesias resolved within 6 months, and in the remaining 3, the intensity of the effect was reduced to the level allowing them to discontinue visiting the clinic. No cases of permanent damage to the brachial plexus nerves or any vascular complications were recorded.

**DISCUSSION**

Performing the so-called “minor hand surgery” procedures under anesthesia delivered by the surgeon without the assistance of an anesthesiologist is slowly gaining popularity in orthopedic and hand surgery departments. This is especially true for epinephrine infiltration anesthesia (WALANT) and, to a lesser extent, plexus and nerve blocks which require prior training, practice and ultrasound equipment to be performed in a safe manner [5–8]. Operating without the involvement of an anesthesiologist has many advantages, with independence from the availability of a physician of this specialty being the greatest. The surgeon can operate at his or her own convenience, at a location of his or her own choice while not being constrained by the numerous requirements imposed by the anesthesiologist prior to delivering anesthesia. This includes the need for numerous biochemical tests, the requirement for patients to be fasting, and the refusals to deliver anesthesia (even regional anesthesia) when even minor deviations in clinical and biochemical parameters are found. Surgeries delivered under these types of anesthesia can also be carried out in properly equipped dressing rooms and not necessarily in the operating theaters. This mode of surgery and anesthesia being delivered by the surgeon him/herself results in significant reduction in the cost of treatment [8].

It is clear that certain safety precautions related to the risk of adverse events or complications related to anesthesia or the surgery itself must be observed. The absence of an anesthesiologist results in responsibility for dealing with such situations being transferred onto the surgeon. The purpose of this study was to analyze whether such events are common and whether they pose any major problems. Most adverse events were related to feeling unwell due to cardiovascular disorders, namely hyper- or hypotension and bradycardia. These were short-lived phenomena that resolved either spontaneously or after medication or fluid transfusion. Only in a few cases did patients require their hospitalization being extended by 1 day. It should be noted that numerous patients presented with concomitant diseases, mainly cardiovascular diseases. Patients receiving medications were advised to take their medication doses as they did at home. In 7 cases, symptoms of prolonged ischemia of the operated finger (pallor and reduced temperature) were observed following WALANT anesthesia to spontaneously resolve after several hours. Individual cases of prolonged spasm of finger arteries following injection of lignocaine with epinephrine, resulting in the threat of finger necrosis, were reported in the literature. In such cases, an antidote consists in the administration of an α-adrenomimetic agent – fentolamine (Regityne), with recommendation involving the drug being injected into the palmar side of the finger. This results in diastole of arterioles and rapid return of normal blood supply to the finger. Fentolamine should be available in any department delivering local anesthesia with epinephrine.
One of the greatest benefits of anesthesia being delivered by surgeons alone is that the very extensive preoperative diagnostic examinations as required by anesthesiologists with regard to diseases and conditions that could potentially cause complications when anesthetizing a patient during surgery, can be avoided. Such precautions are, of course, justified in general or spinal anesthesia, but not in local, regional, WALANT, or even nerve block anesthesia. In the latter cases, the risk of systemic and regional complications is very low, as confirmed in numerous publications, particularly in the meta-analysis by Kurzman et al. [8]. The results of this study provide additional evidence to support this claim. Blood samples were drawn and coagulation parameters were examined practically only in cases of patients reporting history of blood clotting disorders (the question was always asked prior to delivering anesthesia) or patients who had not stopped anticoagulants in time. Patients presenting at the hospital to undergo hand surgery while reporting other serious complaints, such as retrosternal pain, neurological disorders or significant hypertension, were not admitted to the clinic and were not included in this work, which relates only to patients who actually received anesthesia.

As shown by the presented results, the adverse events are very rare and do not cause problems that exceed the capabilities of surgical specialists requiring help being sought from physicians of other specialties. The knowledge of appropriate procedures for the management of adverse events allows safe handling of such situations, without putting the patient’s health or life at risks. Similar results were obtained in numerous studies published in the literature in recent years [1–12].

**Literature review**

Most studies published in recent years relate to the increasing use of WALANT anesthesia for various types of limb surgery, mainly hand surgery. Far fewer papers present the results of regional anesthesia (e.g., brachial plexus block). The latter was discussed, among others, in the first two articles discussed hereinbelow.

Sim et al. presented the results of an analysis of 1994 cases of local and regional anesthesia (brachial plexus block) delivered by surgeons (without an anesthesiologist) prior to hand surgeries. The surgeries were carried out over a 4-year period within the orthopedic department of a public hospital in Singapore. The anesthesia success rate was nearly 100%, with adverse events having occurred in 67 patients (3.4%), and none of them being the reason for transferring the patient to the intensive care unit or resulting in death. Twenty-one patients (1%) required hospitalization being prolonged by 1–2 days. No cases of complications resulting in permanent damage to health were reported. The authors emphasize the benefits of not involving the personnel from other specialties and the significant reduction in costs when delivering surgeries in this fashion [3].

Obata et al. presented the results of fixation of distal radial fractures under brachial plexus block anesthesia delivered by the surgeons themselves under ultrasound guidance. In most cases, the fractures were operated on by palmar plate fixation. Surgeries were performed in a bloodless field, using tourniquet cuffs. Anesthesia was successful in 95 cases (94%), while 6 patients reported nagging pain experienced during the surgery due to the tourniquet placement so that anesthesiologist’s assistance and general anesthesia were required. The authors emphasize that brachial plexus block as delivered by the surgeons themselves is a very good solution, although the assistance of an anesthesiologist is sometimes necessary [10].

At the author’s center, all surgeries for fractures of bones of the hand and the forearm are performed under regional anesthesia or WALANT, with not a single case of anesthesiologist intervention due to ineffective anesthesia being required in the period under review.

Abdullah et al. reported on the results of an analysis of the outcomes of 1073 anesthesias delivered by surgeons themselves (without the involvement of an anesthesiologist) prior to hand surgery procedures. The surgeries were performed over a 5-year period within the orthopedic department of a public hospital in Kuala Lumpur, Malaysia. Most of the procedures were surgeries for carpal tunnel syndrome, trigger finger release, excisions of hand tumors and implant (mainly K-wire) removals. The authors reported no anesthesia-related complications, either local (finger ischemia) or systemic [7].

Kurzman et al. carried out a literature review on the efficacy and safety of WALANT anesthesia in upper limb surgery. The results of their analysis of 80 relevant publications from the period of 2005–2022 are indicative of very high efficacy and safety rates as well as of multiple benefits of operating without the involvement of anesthesiologists. This is especially true in terms of increasing the availability of surgery for high risk patients, reducing waiting times and significantly lowering the cost of treatment. As emphasized by the authors of the studies, this type of anesthesia facilitates surgeries being delivered to patients who are elderly, obese, disabled and burdened with concomitant diseases, in whom standard anesthesia (general or regional) would be associated with the risk of complications and who would be therefore disqualified from...
the surgery by anesthesiologists. This mode of surgery avoids the involvement of additional personnel and reduces the length of time patients spend at health care centers while not compromising their safety. The percentage of adverse events is very low. Another important argument is that anesthesia and surgery in outpatient or “one day” mode is preferred by a vast majority of patients. The economic aspect should also not be disregarded: surgeries delivered in the presented manner generate costs that are 2–3 times lower than those carried out in the standard mode [8].

Numerous other studies published in recent years pointed to the growing popularity of pre-hand surgery anesthesia being performed by the operators themselves (surgeons and orthopedic surgeons) as well as to the high effectiveness and safety of this approach [9, 11, 12]. The advantage of this study consists in the very large study group of more than 22,000 patients. This is the largest material published to date, several times larger than the second largest material published by Lalonde et al. and pertaining to 3,1 thousand patients [5]. Many years of practice and a very large number of patients operated on under anesthesia delivered by the surgeons allow the author to formulate scientifically justified conclusions about the effectiveness and safety of this method for the delivery of anesthesia and the subsequent surgery.

The results presented in this paper show that anesthesia as delivered prior to hand surgery procedures by the surgeons without the assistance of anesthesiologists is effective and safe while being associated with numerous benefits for patients, surgeons and the health care system’s budget.

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