Published online: 2019-08-26

Original Article

Timed wake-up anaesthesia in hand: A modification to wide awake surgery of hand

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ABSTRACT

Introduction: Wide awake surgery of the hand (WASH) is a well-accepted technique in hand surgery which allows the surgeon to identify and rectify on the table of some of the inadvertent shortcomings in the surgical procedures to optimise the final outcome. The advantage, however, precludes the use of tourniquet. We describe a modified method which preserves all the advantages of WASH and allows the surgeon to use tourniquet. **Patients and Methods:** Thirty-one cases of hand surgeries were carried out using the modified technique where a wrist block was supplemented with the ultra-short acting intravenous propofol which allowed the surgeon to use the upper arm tourniquet. The propofol infusion was stopped, and the tourniquet was released after the important surgical step. Within an average of 10 min of stoppage of the infusion, all the patients were awake for active intraoperative painless movements to aid the surgeon to identify, rectify and fine tune the procedure to optimise the results. **Results:** Five of the 31 patients needed correction based on the intraoperative movements. All the 31 patients were pain free at the surgical site during surgery. All the 31 patients were cooperative enough to perform full range of pain-free intraoperative movements. No patient experienced significant tourniquet pain during the procedure. Patient's and surgeon's satisfaction at the end of the procedure has been quite satisfactory. **Conclusion:** Timed wake-up anaesthesia, an improvement over the original WASH, has been suggested where the surgeon can add without subtracting the benefits of the procedure in the form of usage of the tourniquet providing the clear tissue plane and haemostasis during the surgery. However, an additional cost is incurred for the use of anaesthesia and equipment should be kept in mind.

KEY WORDS

Timed wake-up anaesthesia; tourniquet; wide awake surgery of the hand

Access this article online	
Quick Response Code:	Website: www.ijps.org
	DOI: 10.4103/0970-0358.197221

How to cite this article: Kamath J, Shenoy T, Jayasheelan N, Rizwan N, Sachan V, Danda R. Timed wake-up anaesthesia in hand: A modification to wide awake surgery of hand. Indian J Plast Surg 2016;49:378-83.

INTRODUCTION

Local anaesthesia for surgery of the hand is commonly used since ages, but its use is restricted only to minor surgeries. The limiting factor is the requirement of concomitant use of wrist and forearm tourniquet and the associated tourniquet pain which is not well tolerated if the surgery is performed under local anaesthesia.

Technically, surgery of the hand is highly demanding, especially those involving the bone and tendons. The results are directly related to technical precision. The major bugbear of tendon surgery is the post-operative adhesions and rupture. The repair or reconstruction of extensor or flexor tendons in hand should not only be strong enough for early mobilisation but should also be neat and less bulky for uninterrupted gliding of the repaired/reconstructed tendon. Hence, ideally one would like to assess both the strength and the precision of the tendon repair on table before wound closure. The prerequisite for this is the administration of an anaesthetic agent which keeps the extrinsic forearm muscles unparalysed, and an active and alert patient who can respond to the surgeon's command intraoperatively at an appropriate time.

These requirements are met ideally with the established technique of wide awake surgery of the hand (WASH) as proposed and propagated by Lalonde which involves the liberal use of a dilute local anaesthetic agent with epinephrine used in the distal forearm and hand.[1,2]

We share our early experience of Timed wake-up anaesthesia, a modification in the original WASH technique, which will address some of its major drawbacks.

PATIENTS AND METHODS

Between August 2011 to September 2013, we prospectively studied and treated 31 cases involving tendon and bone injuries in the hand in our institution using modified WASH technique. There were 22 males and 7 females in this study with the mean age of 35 years ranging from 17 to 76 years. The inclusion criteria were surgeries involving the hand and fingers requiring repair and/or reconstruction of tendons, bones and joints, where it was decided that an intraoperative active movements would be required to assess the adequacy of surgical technique. The exclusion criteria were surgeries involving more than one limb, age <12 years, very uncooperative patients, surgery in the proximal half of the forearm and above, allergy to xylocaine and surgeries involving nerves and blood vessels. Analysis of the study was done using Chi-square test and Kendall's tau-b as suggested by the team of institutional statisticians. This study was scrutinised and approved by the Institutional and Ethical Committee as per the protocol. All the patients included in the study were explained about the procedure and the need of their cooperation for the intraoperative active movements for the better results.

Procedure

All the surgeries were done using wrist block (by the surgeon) supplemented with sedation and analgesia administered by anaesthetist. Premedication in the form of intravenous (IV) midazolam (0.02 mg/kg) and I.V fentanyl (0.5 mcg/kg) was administered by the anaesthetist. This was followed by a bolus of 30 mg IV propofol administration. Propofol is well known for its short-acting anaesthetic action.[3] When this combination induced analgesia, surgeon was allowed to give the wrist block using 1% lignocaine with 1:100,000 adrenaline for median, ulnar and superficial branch of radial nerve [Figure 1]. All patients were subjected to test dose of xylocaine to rule out hypersensitivity at least 1 h preoperatively. Three to 5 ml were used for each nerve and if the surgical field was in the forearm, the local anaesthetic agent in the same concentration was used as a local infiltration. This combination of local anaesthesia and short-acting analgesic agent allowed the surgeon to use the upper arm tourniquet for the precision work without the loss of tissue plane. Once the surgery was

Figure 1: The sites of injection for peripheral nerve block at the wrist level

started and if the expected surgical time was more than 15 min (in all 31 cases) and IV propofol infusion was started at a dose of 50 mcg/kg/h. The infusion was stopped 10 min before the surgeon wanted the patient to actively cooperate for intraoperative movement. This generally coincided with the tourniquet release and maintenance of the haemostasis using diathermy. Generally, at the end of 10 min of stoppage of the propofol infusion, with the tourniquet down and haemostasis achieved, patients were awake and alert enough to respond to the surgeon's command. The patient was asked to perform full range of desired and gentle active movements with 3 repetitions to assess the competency and precision of the repair or reconstruction such as strength of the tendon repair, passage of the tenorrhaphy through the pulley, tension of the graft in tendon surgeries and rotational malalignment in fracture fixation. The wrist block was repeated if needed after 75–90 min of the first block. Once the surgeon was happy with the assessment of the intraoperative movements by the patient who was completely awake cooperating the surgeon, the propofol infusion was either discontinued (if the surgeon could suture the wounds with analgesia provide by the wrist block) or restarted till the end of the surgery (in apprehensive patients). In a true sense, this procedure amounts to 'Timed Wake-up Anaesthesia In Hand'.

Videography of the patients actively moving the fingers intraoperatively was performed in all the cases so that they could be shown postoperatively both to the patients and the therapists for a better and successful outcome.

The aims of the study were not only to analyse the advantages and disadvantages of the WASH but also to assess the patients for the following details:

1. Pain experienced at the surgical site by the patient during surgery
2. Tourniquet pain
3. Adequacy of the intraoperative movements performed by awake patients
4. Need for altering the surgical procedures following the assessment of intraoperative movements
5. Degree of sedation experienced by the patient
6. Overall patient's and surgeon's satisfaction regarding the procedure.

RESULTS

None of the 31 patients experienced pain at the surgical site during the surgery or during intraoperative movements. In 22 patients, the wrist block was repeated after 1 h of surgery with the dose of 2–3 ml of 1% of xylocaine with adrenaline for only those nerves which were supplying the sensation for the surgical field.

The average tourniquet time was 48 min, and it did not exceed the normally accepted time and pressure. Assessment of tourniquet pain was done using the visual analogue scale (VAS) of 1–10 (1 - no pain to 10 - severe pain). A score of 3 and above was considered significant. Out of 31 patients, only 2 patients complained of significant tourniquet pain (VAS score 3 and above). Their scores were 4 and 6, respectively, and they were seen during the early part of our study when the propofol drip was stopped too early without deflating the tourniquet. Its only after this experience, we adopted stopping the propofol infusion and simultaneous release of tourniquet about 10 min before the anticipated time for intraoperative movements. We found that at the end of 10 min of stoppage of the infusion, all the patients were awake enough to respond for active movements.

Patients who performed full range of desired active movements intraoperatively three times successively were considered acceptable. All the 31 patients performed full active range of desirable movements at least 3 times intraoperatively. Twenty-six patients out of 31 were wide awake at the end of the 7 min of stoppage of the infusion.

In Five cases out of 31, the intraoperative movements helped the surgeon to detect the technical shortcomings and prompted an appropriate correction. On two occasions during flexor tendon repair in zone 2, the pulley venting was required for smooth gliding of the repair. Tension adjustment of the repair had to be revised in two occasions one each during flexor tendon grafting (for an old untreated zone 2 injury) and tendon transfer (Srinivasan's procedure for the correction of Wartenberg's sign in intrinsic paralysis). On both the occasions, the original repairs were slack, as demonstrated by incomplete active flexion of digit/adduction of the little finger during three successive attempts of active movements intraoperatively. On one occasion, the extensor repair in zone 4 over the shaft of the proximal phalanx gave way on full flexion, and it had to be redone in a stronger way. This prompted us to consider extensor tendon injury beyond zone 5 and distal as exclusion criteria as risk–benefit ratio of this method in such cases was found unfavourable.

The degree of sedation was assessed using Ramsay Sedation Score (1 - anxious and restless to 6 - no response). Twenty-nine out of 31 patients scored 4 and above on Ramsay Sedation Score. Only two patients scored 2 and 3, respectively, but both of them were diagnosed on table and rectified by increasing the infusion rate of propofol drip.

In the post-operative period, both the patients and the senior surgeon were asked about the satisfaction of anaesthesia and operating conditions. Both of them separately graded their experience into not satisfactory, satisfactory and very satisfactory. Twenty-seven of 31 patients graded the procedure as very satisfactory and the other four patients opted for satisfactory grade. The senior surgeon graded thirty cases as very satisfactory and graded only one as satisfactory where he encountered rupture of the extensor repair in zone four over the finger. However, the weak repair was revised and did not compromise with the results.

There were no untoward effects experienced by the patients such as nausea and vomiting. Because of the motor blockade of the intrinsic muscles of the hand due to median and ulnar nerve at the wrist, no attempt was made or possible to assess the function of the intrinsic muscles intraoperatively. When we use this method in case of opponenceplasty or extensor indicis to extensor pollicis transfer, the donor tendons were assessed intraoperatively. All the patients who underwent this procedure wished to be operated with the same method for the next time if need be (Tables 1 and 2).

Table 1: List of tendon-related cases done under wide awake surgery of the hand with tourniquet

Tendon related	*Number of cases*
Flexor tendon repair	
FDS and FDP zone 2	3
FDS and FDP zone 3	1
Flexor tenolysis	
Zone 2	3
Flexor tendon grafting	
Zone 2	5
Extensor tendon repair	
Zone 4	1
Zone 5	1
Tendon transfer	
EPL to EI	2
Wartenberg's sign correction	1
Opponensplasty	1
Total	18

FDS: Flexor digitorum superficialis, FDP: Flexor digitorum profundus, EPL: Extensor pollicis longus, EI: Extensor indicis

Table 2: List of osteoarticular cases done under wide awake surgery of the hand with tourniquet

Osteoarticular related	*Number of cases*
Metacarpal	
Metacarpal fracture	3
Third metacarpal malunion corrective osteotomy	1
Phalangeal	
Fractures	3
Malunion	1
PIP joint	
Arthrodesis	2
Unreduced dislocations	2
MCP joint	
Arthroplasty	1
Total	13

MCP: Metacarpophalangeal, PIP: Proximal interphalangeal

DISCUSSION

The intraoperative identification of surgical precisions has employed in several procedures such as spine,[4] arthroscopic[5] and arthroplasty[6] surgeries with the advent of somatosensory evoked potentials and intraoperative navigation methods. A similar advantage in hand surgery was provided with the concept of WASH proposed by Lalonde, wherein a fully awake patient cooperates with the surgeons in performing intraoperative active movements to diagnose any technical flaw and rectify the same immediately to optimise the final surgical results. The highlights of the technique are (1) wide awake patient during surgery, (2) no tourniquet and hence tourniquet pain and (3) 1% xylocaine plus epinephrine as anaesthetic agent, avoiding all the complications related to general anaesthesia and proximal blocks in the arm. The advantages of intraoperative movements are identification, avoidance and rectification of gapping and triggering of tendon repairs, stronger repair or reconstruction for early mobilisation of injured fingers, on table confirmation both for the surgeon, patient and therapist for better final outcome. However, we observed some of the disadvantages of the original WASH technique such as: (1) the technique is painful to the patient as it involves multiple injections and when it is not administered as described by Donald Lalonde it could be very unpleasant for the patients, (2) the waiting period was more than 20–30 min after the multiple injections (3) tissue plane is distorted completely due to the tumescent anaesthesia, (4) adequate

haemostasis was not acquired due to non-availability of tourniquet, (5) patient apprehension, especially in children and (6) unwanted movements during surgery, when the duration exceeds more than an hour or so.

We believe that the patient has to be awake essentially to perform active movements involving fingers to aid surgeons to access the adequacy of the procedure. The modified technique that we have used has preserved all the advantages of the original one but allows the surgeon to use tourniquet providing him the perfect haemostasis and plane that he is accustomed to. It also avoids painful multiple injections and takes care of apprehension in children. More importantly, it brings back the anaesthetist in the team to take care of any adverse eventualities in this era of medicolegal litigations.

We believe, in our set-up, the advantages of the modification outweigh the disadvantages of subjecting the patients for the ultrashort-acting sedative and tranquiliser and the additional cost involved for anaesthesia and equipment. Although the repaired/reconstructed tendon can be assessed by passively pulling the tendons or by doing the wrist tenodesis test on the table, we believe that they are at best indirect and incomplete method of accessing the repair on the table. The controlled full range of active movements by the patient himself on the table, and that too three consecutive times as practised by us may be the better way to confirm the adequacy of the repair of the tendons on the table Figures 2-6.

Figure 2: A case of 3-day-old zone 2 flexor tendon injury involving mid and ring fingers with an old injury to the little finger treated by primary repair. The pre-, intra- and final post-operative movements

Figure 4: A case of partial ulnar nerve palsy with symptomatic wartenberg's sign of inability to adduct the little finger. Pre-, intra- and post-operative movements. The initial intraoperative movements suggested the Palmaris tendon graft repair during Srinivasn's procedure was slack and hence revised intraoperatively by tightening the same and reconfirming on table

Figure 3: A case of post-traumatic sequalae with loss of flexor tendon and intra-articular injury involving proximal interphalangeal joint with supple joints treated with flexor tendon grafting for ring finger. The pre-, intra- and post-operative movements

Figure 5: A case of 7-week post-traumatic dorsal dislocation of PIP joint treated with open reduction and volar plate reconstruction. Pre-, intra- and post-operative movements

Figure 6: A case of unstable fracture neck of 5th metacarpal bone treated with open reduction and internal fixation with bone tie. Pre-operative scissoring of the little finger, correction and confirmation of the same intraoperatively

SUMMARY AND CONCLUSION

The modification that we are proposing is an alternative one and does not dilute the primary purpose of the original description but helps the generations of surgeons who are used to tourniquet and its benefits. The early good results are encouraging and reproducible in any set-up and would be an easier first step for converting from conventional to original WASH technique.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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