

Intravenous lidocaine anesthesia for ambulatory surgery of the upper extremities : Experience in Queen Sawang Wattana Memorial Hospital

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Objective : *To evaluate the effectiveness and safety of intravenous lidocaine anesthesia for upper extremity surgery*

Setting : *Ambulatory Surgery Department of Orthopaedic Surgery, Queen Sawang Wattana Memorial Hospital*

Design : *Descriptive retrospective study*

Materials and Methods : *Intravenous lidocaine anesthesia was given to 38 patients who underwent surgery of the upper extremities as ambulatory patients. The patients were classified into two groups before surgery. Group one comprised 33 patients whose surgery was estimated would be completed within 20 minutes. This group received double arm tourniquets and lidocaine at a dosage of 4 mg/kg. Group two comprised 5 patients who received single forearm tourniquet and lidocaine at a dosage of 3 mg/kg as well as 1 patient for whom bilateral surgery was performed applying the same technique. For both groups, the lidocaine*

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concentration was 0.5%. Effectiveness was evaluated by completeness of numbness without any local injection being given. The order of sensory change from injection to complete numbness was also recorded.

In order to evaluate systemic symptoms of lidocaine and anesthetic time, the patients were classified into two groups. In group one, the anesthetic time was less than 30 minutes. With 20 patients in this group, the tourniquet was gradually deflated by releasing it for 15 seconds, inflating it again for 30 seconds and then deflating it. In another group of 18 patients, the tourniquet was not gradually deflated. Symptoms of palpitation and dizziness in connection with lidocaine systemic symptoms were recorded and the relation to anesthetic time was analyzed.

- Results** : * Complete numbness without additional anesthesia was noted in all 38 patients.
- * The order of sensory change starting with cold over hot to a tingling sensation and then numbness was recognized by 35 patients.
- * No serious complications occurred in any of the 38 patients.
- * Systemic symptoms occurred in 7 patients, all of whom had had anesthetic times of less than 30 minutes.
- Conclusions** : It can be concluded that intravenous lidocaine anesthesia is safe and effective for ambulatory surgery of the upper extremities. The four steps of sensory change represented quite an interesting and constant finding but may not have clinical significance. Thirty minutes may constitute the upper limit of anesthetic time that will not cause systemic symptoms.
- Key words** : Intravenous lidocaine anesthesia, Ambulatory surgery, Upper extremity.

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ลิโดเคนเข้าทางหลอดเลือดดำในผู้ป่วยที่มารับการผ่าตัดบริเวณแขนและมือแบบผู้ป่วยนอกใน
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โดยมีผู้ป่วย 2 กลุ่ม กลุ่มแรก จำนวน 33 คน เป็นผู้ป่วย ซึ่งคาดว่า
การผ่าตัดจะสำเร็จในเวลานานกว่า 20 นาที ใช้ double tourniquet
พันรัดที่ต้นแขน ขนาดของยาชาลิโดเคน 4 มก./กก. กลุ่มที่สอง
จำนวน 5 คน ซึ่งการผ่าตัดคาดว่าใช้เวลาน้อยกว่า 20 นาทีใช้
single tourniquet พันรัดที่แขนบริเวณต่ำกว่าข้อศอกเล็กน้อย ขนาด
ของยาชาลิโดเคนเป็น 3 มก./กก. โดยในกลุ่มที่สองมีผู้ป่วย 1 ราย
ได้รับการผ่าตัดทั้งสองข้าง ถามความรู้สึกที่เปลี่ยนแปลงหลังจากเริ่ม
ฉีดยาเข้าหลอดเลือดดำ ตามลำดับได้แก่ เย็น ร้อน ความรู้สึกเหมือน
มดไต่ (tingling) แล้วจึงชา แล้วบันทึกว่าผู้ป่วยสามารถสังเกตการ
เปลี่ยนแปลงของความรู้สึกได้กี่ราย สังเกตประสิทธิภาพของการให้
ยาชาวิธีนี้ว่ามีประสิทธิภาพหรือไม่ โดยบันทึกว่ายาชาออกฤทธิ์เพียง
พอที่จะทำผ่าตัดได้ โดยไม่ต้องให้ยาชาเฉพาะที่ (Local injection)
เพิ่ม ความรู้สึกที่ไม่สบายของผู้ป่วยระหว่างการผ่าตัดหรือไม่ (อาการ
ใจสั่น วิเวียนศีรษะ)

หลังจากเสร็จผ่าตัดแบ่งผู้ป่วยเป็นสองกลุ่ม กลุ่มแรกการ
ผ่าตัดเสร็จภายใน 30 นาที มี 20 คน ปลดtourniquet ซ้ำ ๆ
โดยปลด 15 นาทีขึ้นใหม่ 30 วินาที แล้วจึงปลดtourniquet
กลุ่มที่สองการผ่าตัดเสร็จในเวลานานกว่า 30 นาที มี 18 คน ปลด
tourniquet เลย โดยไม่ต้องขึ้นใหม่ ทั้งสองกลุ่มเฝ้าสังเกตอาการที่
เกิดขึ้นหลังปลดtourniquet ซึ่งเป็นอาการทั่วไปของยาชาลิโดเคน
คือใจสั่น วิเวียน

- ผลการศึกษา** : พบว่าผู้ป่วย 35 ราย จาก 38 ราย สามารถสังเกตการเปลี่ยนแปลงของความรู้สึกตั้งแต่เริ่มฉีดยาชาเข้าหลอดเลือดดำจนกระทั่งชาเต็มที่มี 4 ขั้นตอน ดังที่กล่าวมาแล้วได้ ทั้ง 38 ราย ความรู้สึกที่เกิดขึ้นเพียงพอสำหรับการผ่าตัดโดยไม่ต้องให้ยาชาเพิ่มเติม
- ไม่พบอาการข้างเคียงรุนแรงในผู้ป่วยทั้ง 38 ราย
- มีผู้ป่วย 7 ราย ในกลุ่มซึ่งการผ่าตัดเสร็จภายใน 30 นาที เกิดอาการข้างเคียงคือเวียนศีรษะ และใจสั่น โดยทั้ง 7 ราย อาการดีขึ้นภายใน 15 นาที หลังจากพัก
- วิจารณ์และสรุป** : ผลการศึกษพบว่าวิธีการให้ยาชาลิโดเคนเข้าหลอดเลือดดำสำหรับการผ่าตัดบริเวณแขนและมือในผู้ป่วย ซึ่งมารับการผ่าตัดแบบผู้ป่วยนอกเป็นวิธีที่ให้ผลดีมีประสิทธิภาพ และมีความปลอดภัย โดยไม่พบอาการข้างเคียงของยาชา ในระหว่างการผ่าตัดการเปลี่ยนแปลงของความรู้สึกตั้งแต่เริ่มฉีดยาชา กระทั่งชาเต็มที่มี 4 ขั้นตอน เป็นสิ่งที่สังเกตพบที่น่าสนใจ แต่อาจไม่มีความสำคัญทางคลินิก และถ้าการผ่าตัดเสร็จภายใน 30 นาที ต้องเฝ้าระวังติดตามผู้ป่วยโดยใกล้ชิด โดยการปล่อย tourniquet ต้องทำแบบ gradual deflation และต้องเฝ้าระวังผู้ป่วยอีกกระยะหนึ่ง เนื่องจากผู้ป่วยมีอาการข้างเคียงของยาชาลิโดเคน
- นอกจากนี้ ผู้รายงานได้แสดงเทคนิคการให้ยาชาวิธีนี้โดยละเอียด ซึ่งผู้สนใจควรได้อ่านและทำความเข้าใจเพิ่มเติม

For surgery of the upper extremities many operations can be carried out as ambulatory surgery. In most circumstances, anesthesia is given by the surgeon himself, be it regional but not general anesthesia. Intravenous anesthesia ranges among various techniques is frequently used by us because it provides very reliable, rapid and profound anesthesia, and is considered safe. We report our experience with this technique and would like to confirm that it is effective and safe.

Materials and Methods

The data were collected from 38 patients who underwent operations of the upper extremities as outpatients in Queen Sawang Wattana Memorial Hospital between May 1996 and January 1998. Our inclusion criteria were 1. Well - communicated ASA Class I and II patient without history of lidocaine hypersensitivity, 2. Cases where profound anesthesia was required, 3. Surgical field proximal to the proximal interphalangeal joint (PIPJ) where a digital nerve block

might not be adequate, 4. Surgery at the ring finger where complete anesthesia with nerve block must be a total wrist block and 5. Surgery should be finished within 45 minutes. The sex distribution was 20 males and 18 females with an average age of 36.3 years (17 - 54 years).

As the average time for tourniquet tolerance was 20 minutes and a forearm tourniquet was tolerated better than an upper arm tourniquet, a single forearm tourniquet was used if we estimated that the operation would be finished within 20 minutes. A double arm tourniquet was used when we were not sure that the operation would be finished that quickly 20 minutes or if the surgery was performed at the forearm where a forearm tourniquet would obstruct the operation. The position of the tourniquet determined the dosage of lidocaine as pointed out below

- * Double upper arm tourniquet, 33 cases
- * Single forearm tourniquet, 3 cases
- * Single forearm tourniquet – bilateral, 2 cases

Table 1. Shows the operations performed in these patients.

Procedure	No of Patients
* Ganglion excision	6
* Open carpal tunnel release with ligamentoplasty	4
* Endoscopic carpal tunnel releas - unilateral	5
- bilateral	2
* Full thickness skin grafting of the hand	1
* Tendon transfer (PT to ECRB)	1
* Repair of superficial radial nerve at forearm	1
* Tendon repair	
- Extensor (Hand)	3
- Flexor Zone II (single digit)	2
* Implant removal	3
* Fracture fixation	
- Hand	7
- Forearm plating (one bone)	2
- Closed pinning distal radius	1

Techniques

- Every step must be performed properly and carefully to prevent serious complications.

First step: applying the tourniquet

- For a single forearm tourniquet, the cuff was placed over the forearm muscle mass just below the elbow

- For a double tourniquet, we prefer the double tourniquet machine which can provide pressure for both cuffs and has digital gauges for pressure and time, which is much easier to read. Both cuffs were placed on the arm proximal to the elbow, taking care that no space was left between the tourniquets, the second cuff (blue) at the distal end and the main cuff

(red) at the proximal site. Lacking a double tourniquet machine, care must be taken as to which is the distal or proximal tourniquet.

- All cuffs must be firmly applied and the joint must be securely attached to prevent tourniquet leakage.

Second step: Preparation of anesthetic agent and IV line

Dosage: We used 0.5 % plain lidocaine, the dosage was 4mg/kg for a double arm tourniquet and 3 mg/kg for a single forearm tourniquet and also 3 mg/kg for each side in cases of bilateral operation with a single forearm tourniquet.

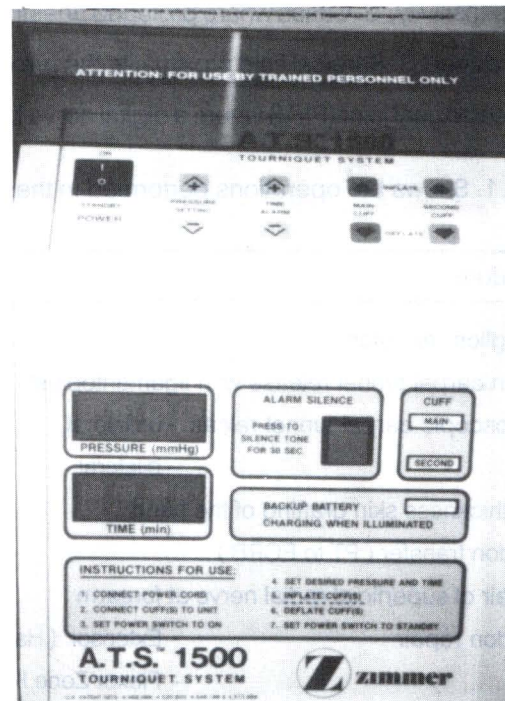


Figure 1. The double tourniquet machine.

Example of calculation

1. % Concentration lidocaine x 10 = concentration in mg/ml

E.g. 0.5 % lidocaine x 10 = 5 mg/ml

2. $\text{Dose (mg/kg)} \times \text{body weight (kg)} = \text{volume used (ml)}$

lidocaine concentration (mg/ml)

E.g. $4 \text{ (mg/kg)} \times 50 \text{ (kg)} = 40 \text{ ml of 0.5 \% lidocaine}$

5 (0.5 % lidocaine)

(40 ml of 0.5% lidocaine derived from diluting 1 % lidocaine 20 ml to 40 ml or 2 % lidocaine 10 ml to 40 ml)

After preparing the anesthetic agent, the IV line was prepared by insertion of a plastic IV catheter No.22 or 24 . We prefer the dorsal vein of the hand as it is much easier to insert the catheter, but the volar vein at either wrist or the forearm veins can also be used. The plastic catheter was temporarily taped in place. A patent IV line without leakage is essential.

Third step: Exsanguination and administration of anesthetic (agent)

* The limb is wrapped with a nonsterile stockinette and exsanguinated with an Esmarch bandage starting from the fingers all the way up to the tourniquet. Thorough exsanguination is the most important part of the technique. Without it, the anesthesia is likely to be spotty, the operative field bloody , and the patient likely to have early tourniquet pain. After exsanguination the tourniquet was inflated, with double tourniquets the distal second tourniquet was inflated first followed by the proximal (main) tourniquet and then the distal tourniquet was released. Tourniquet pressure was 250 mmHg. The lidocaine (0.5 %) was injected via the provided IV line, and then the catheter was removed. Surgery can be started within a few minutes.

Forth step: Inflation of the second tourniquet

* If the patient could not tolerate the tourniquet discomfort, the second tourniquet, now wrapped over the anesthetic area, was inflated, and the proximal tourniquet was deflated (in the following step). The second (distal) tourniquet should be inflated before releasing the proximal tourniquet.

* During the entire procedure, all patients was clinically monitored by observing systemic symptoms of lidocaine toxicity such as lightheadedness, dizziness, buzzing in the ears, palpitation etc. Resussitative equipment was always checked to be immediately available.

Results

* The average tourniquet time was 36 minutes (17-49)

* The average tourniquet time loss (from inflation to making an incision) was 4.7 minutes (4 -7)

* All 38 patients achieved profound anesthesia without any additional anesthetic

* No serious adverse effects were noted in any of the 38 patients

* Changes in sensitivity from injection to complete numbness were in the order of

Cold → Hot → Tingling → Numbness

anesthetic noted by 35 patients and in all cases, complete numbness occurred within 1 minute after injection.

Systemic symptoms (palpitation and dizziness) occurred in 7 cases, but were resolved within 15 minutes after tourniquet deflation. With all 7 cases, the operation was finished within 30 minutes.

Total operation time (minutes)	With systemic symptoms	Without systemic symptoms
A. < 30	7	13
B. > 30	0	18

The tourniquet was gradually deflated in all 20 cases in group A.

Discussion

Health care in our country is limited by budget and lack of medical staff, thus ambulatory surgery is much preferred. Along with the daily case load, surgeons like to operate on as many cases per schedule as is possible but this doesn't exactly inspire confidence in patients. The operating field is another obstacle, since when operating in deep tissue as on tendons, or bones proximally in the forearm, local infiltration and peripheral nerve block are rendered useless. Brachial block and general anesthesia are not suitable because both require technical expertise and have risks of serious complications. Brachial block is also time consuming and less reliable, depending on the physicians, but it can be used in higher operative fields like the elbow or arm as well as in more extensive operations, but most ambulatory surgery cases are of short duration. Intravenous anesthesia is preferred because it is simple, fast and very reliable.

About the recommended dosage of lidocaine vary from 1.5-3 mg/kg^(1,2) to 3-4 mg/kg⁽³⁻⁵⁾ and 3-5 mg/kg^(6,7) and we used 3-4 mg/kg as it gave rapid and profound anesthesia. For fear of systemic toxicity, we think high dosage is not the sole factor. The toxicity may be related with factors that cause high venous pressure during injection⁽¹⁾ such as placement of proximal canula, poor exsanguination before blockade

and rapid injection, so slow injection via a distal canula into an arm which has been exanguinated as efficiently as possible is recommended.

Our experience with 38 patients was quite satisfactory regarding profound anesthesia and safety because no serious complications occurred in any of the cases, except for systemic reaction in 7 cases. The technical details and precautions mentioned should be reviewed and strictly followed. The order of sensory change before numbness was quite constant (35 of 38 cases). Empirically, systemic symptoms will not occur if the duration of anesthesia is longer than 20 minutes, so it is recommended that if the anesthetic time is less than 20 minutes, the tourniquet should be gradually deflated, and after 40 minutes the tourniquet can be safely deflated without reinflation. Anesthetic times between 20 minutes and 40 minutes is the grey zone. In our 7 cases with systemic symptoms we found that in some cases the anesthetic time was between 20 and 30 minutes without gradual tourniquet deflation. Possibly, the safe anesthetic time requiring gradual deflation of the tourniquet may be 30 minutes instead of 20 minutes.

As the average arm tourniquet tolerance was 20 minutes⁽⁸⁾ and the forearm tourniquet was better tolerated than the arm tourniquet,⁽⁹⁾ if the operation could be finished within 20 minutes we used a single forearm instead of a single arm tourniquet since firstly,

we could minimize the lidocaine dose to 3 mg/kg and secondly, for better tourniquet tolerance in cases of the operation exceeding 20 minutes. With operations exceeding 20 minutes or those located very proximally in the forearm we used a double arm tourniquet with a 4 mg/kg dosage of lidocaine. Both techniques work well but we have not tried the Minidose Bier Block for fear that it will not be adequate. Also in our 2 cases of bilateral operation with single forearm tourniquet and a lidocaine dosage of 3 mg / kg no systemic symptoms occurred.

Regarding lack of muscle relaxation, in all cases of complete numbness we also noted paralysis of the muscle but this was not complete, which may be desirable for some operation as for example tenolysis. Three cases of forearm operation (plating of forearm bones and 1 tendon transfer) could be carried out without difficulties. Small amounts of relaxants may be added to the local anesthetic mixture.

As to extension of the anesthetic time, generally one hour was the upper limit even with double tourniquet. The anesthetic time can be prolonged by local injection at the medial arm to decrease the tourniquet pain, by a second wrap technique or repeated injection but we prefer to finish the operation within the allotted time. Our most extensive operation lasted 49 minutes with proximal tourniquet discomfort even though this tourniquet covered the anesthetized part.

For monitoring, we carried out the procedure by clinical observation only as mentioned, but all patients were carefully selected. Only ASA Class I and II⁽¹⁰⁾ patient with no contraindications of this method other than known hypersensitivity to lidocaine⁽²⁾ as patients with epilepsy; patients with severe vascular, neurological or hemolytic disease

(where use of a tourniquet was contraindicated); patients with hepatic diseases; patients with pre-existing cardiac dysrhythmias can be used. Early symptoms of lidocaine overdose⁽³⁾ are those of central nervous system irritability such as giddiness, lightheadedness, buzzing in the ears etc. It is uncommon for signs of cardiovascular depression to appear early but they can occur as the initial toxic manifestation. Muscular twitching is a common toxic sign. Further increases in blood lidocaine levels can lead to convulsion and respiratory distress. While these serious symptoms are usually heralded by lightheadedness etc. these warning signs may be absent. Essential treatment for the systemic reactions to local anesthetic agents is the administration of oxygen. After tourniquet deflation the patients should be monitored for at least 30 minutes as pharmacokinetic studies^(11,12) revealed that even 30 minutes after cuff release about 50 percent of the dose still remained in the arm.

Intravenous lidocaine anesthesia has a few disadvantages other than the limited anesthetic time mentioned. Surgery on infectious areas and tumours is contraindicated because of exsanguination although limb elevation for 1-2 minutes has been reported to be adequate to produce a bloodless field.⁽⁶⁾ In conclusion, we found that intravenous lidocaine anesthesia was safe and effective when properly performed in well-selected cases.

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