LIDOCAINE AND FENTANYL WITH DISTAL FOREARM INTRAVENOUS REGIONAL ANESTHESIA

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ABSTRACT

Background: Intravenous regional anesthesia is one of the safest and most consistent modes of regional anesthesia for short procedures on upper extremity. **Objectives:** To evaluate the combination of lidocaine 1 mg/kg with fentanyl 12.5 μg with double cuff distal forearm tourniquet 3 cm above the wrist for short procedures of the hand surgery. **Materials and methods:** 20 patients scheduled for outpatients short procedures of hand surgery, with one cannula over the dorsum of the operated hand for local anesthetic injection and the other cannula on the other hand for crystalloid infusion during the operation. Lidocaine 1 mg/kg diluted to 10 ml normal saline with fentanyl 12.5 μg diluted to 10 ml normal saline injected over 30 seconds with distal forearm tourniquet placed 3 cm above the wrist. **Results:** Sensory block started after 3.5 minutes with preserved motor power of the wrist muscles. The operative VAS is 1. Patients haemodynamically stable during the operation with 13 patients very satisfied. Also, surgeon is very satisfied in 15 patients during the procedures. **Conclusion:** Lidocaine with fentanyl with distal forearm tourniquet is safe method with rapid onset and effective anesthesia.

Keywords: lidocaine, fentanyl, forearm tourniquet

INTRODUCTION

Intravenous Regional Anesthesia (IVRA) was first used in 1908 by Bier. It is safe, rapid and effective method for providing anesthesia. At the same time, it provides a bloodless operative field for hand surgery. Conventional IVRA has some disadvantages, including the potential for local anesthetic toxicity and lack of postoperative analgesia. I[(1)].

The precise mechanism for production of anesthesia after IVRA remains unknown. Other investigations have suggested that retrograde intravenous pressure infusion leads to high tissue concentrations of local anesthetic by intensifying the filtration and diffusion of molecules into the local interstitium[(2)].

Traditionally, an upper arm tourniquet has been used for those procedures. However, the recommended doses of local anesthetics for upper arm IVRA have the potential risk of systemic toxicity[(3, 4)].

Forearm IVRA, however, allows the dose of local anesthetic to be decreased by up to 50% without affecting the quality of analgesia. In addition, the forearm tourniquet can be tolerated longer and was consistently rated as less painful when compared with the upper arm tourniquet[(5)].

Forearm IVRA allows for preservation of some motor function of the long flexors and extensors of the wrist and hand, which is useful in certain operations such as tenolysis[(6)].

However, this technique was unpopular in the past because it was thought that compression forces of an inflated forearm tourniquet cannot obliterate the anterior and posterior interosseous arteries seated in the deep 'valley' between the prominent radius and ulna[(7)].

It was therefore assumed that tourniquet leakage was inevitable, thus increasing the possibility of local anesthetic toxicity and block failure. A quantitative study showed that forearm IVRA results in tourniquet leakage comparable with upper arm IVRA[(8)].

Intravenous regional anesthesia is one of the safest and most consistent modes of regional anesthesia for short procedures on upper extremity. In spite of this, it has been limited by tourniquet pain, and lack of ability to offer postoperative analgesia. The best IVRA solution should have the following characteristics: fast onset, low dose of local anesthetic, decreased tourniquet pain, and extended postdeflation analgesia[(9)].

PATIENTS AND METHODS

Patients:

After written informed consent, 20 patients ASA I and II were scheduled for hand operations for different causes under forearm tourniquet local intravenous anesthesia, patients aged from 20 years to 50 years.

Patients with liver diseases, renal dysfunction, cardiac conduction abnormalities, history of epilepsy, allergy to local anesthetics, diabetic neuropathy and coagulation abnormalities were excluded from the study.

Patients who received preoperative analgesics, opioids or sedatives were excluded.

Method:

- When patient arrived to operating room, measurement of blood pressure, heart rate, ECG and pulse oximetry monitoring before anesthesia.
- Two cannulas; one in the dorsum of the operated hand for local anesthetic injection, and the other cannula on the other forearm for crystalloid infusion during the operation.
- Double tourniquet placed over the forearm, 3 cm from the wrist.
- The patient blood pressure measured before inflation of the tourniquet cuff. After exsanguinations with Esmarch bandage, the cuff was inflated to a pressure of 100 mmHg above systolic blood pressure. The proximal cuff firstly inflated then distal cuff after 10 minutes before injection of local anesthetic drug, radial and ulnar arterial pulses were checked manually, and by pulse oximetry probe to ensure the efficacy of the tourniquet cuff.
- Lidocaine 1 mg/kg diluted to 10 ml normal saline was injected with 12.5 μg fentanyl diluted to 10 ml normal saline (total, 20 ml) slowly over 30 seconds.
- Evaluation of sensory block by pinching with forceps and the start of sensory block was recorded. Also, the motor block assessed by asking the patient to move the fingers and wrist.
- Intraoperative pain recorded using 10 linear visual analogue scale known by the patient before starting of anesthesia with 0 point of no pain and 10 point of maximum pain.
- Intraoperative haemodynamic changes with systolic and diastolic blood pressure measurements every 5 minutes.
- Postoperative patient satisfaction during the operation and surgeon satisfaction after the operation.
- Time of start of postoperative pain and first time of analgesic requirement were recorded.
- Follow-up of the patient at the second day after 10 days for silk removal and to check postoperative wound infection.

RESULTS

Table (1) showed the patient characteristics of 20 patients with 12 males and 8 females, with age ranging between 18-50 with average of 28.5 years and showed that all patients were haemodynamically stable, systolic 138 ± 8 mmHg and diastolic 78 ± 6 mmHg, also the types and number of operations with ganglion 12 cases, 5 cases with carpal tunnel release and 3 cases with trigger finger.

But, in table (2), the time onset for sensory block was 3.5 minutes with range of 2.5-5.5 minutes. Motor block reduced by not completely blocked. Main tourniquet time was 20.5 minutes with range of 10-28.5 minutes, the operative VAS was 1 point with range of 1-10 points. All patients were haemodynamically stable during the operation with systolic blood pressure of 140 ± 5 mmHg and diastolic blood pressure of 80 ± 4 mmHg, compared with the basal haemodynamic data, follow-up second day showing no infected cases, but follow-up after 10 days showed one case with wound infection. Time of first pain and analgesic administration was 120 ± 15 minutes.

Table (3) showed the degree of patient satisfaction after the operation with 13 patients very satisfied, 5 cases satisfied and 2 cases somewhat satisfied.

In table (4), the surgeon was very satisfied in 15 cases and satisfied in 5 cases only.

Table (1): Patient characteristics

Character	
Number of patients	20
Male/female	12/8
Mean age (range) in years	28-5 (18-50)
Blood pressure	
Systolic	138 ± 8
Diastolic	78 ± 6
Types of operations	
Carpal tunnel release	5
Ganglion excision	12
Trigger thumb	3

Table (2): Operative data

Data	
Sensory block onset time	3.5 (2.5-5.5)
Motor block	Reduced put preserved
Main tourniquet time	20.5 minutes (10-28.5 minutes)
Operative VAS	1 (1-10)
Time of 1st pain > 3 VAS	120 ± 15 minutes
Intraoperative blood pressure	
Systolic	140 ± 5 mmHg
Diastolic	80 ± 4 mmHg
2nd day follow-up	No cases of infection
10th day follow-up	One case

Table (3): Patient satisfaction

Degree	**Number**
Very satisfied	13
Satisfied	5
Somewhat satisfied	2
Unsatisfied	0
Very unsatisfied	0

Table (4): Surgeon satisfaction

Degree	**Number**
Very satisfied	15
Satisfied	5
Somewhat satisfied	0
Unsatisfied	0
Very unsatisfied	0

DISCUSSION

The value of Bier's block for manipulation of fractures and for operations on the upper limb is well recognized. It was pioneered in 1908 by Bier and become popular for limb surgery. Traditionally, a forearm tourniquet was not used, because it was thought that forearm tourniquet cannot occlude the arteries located between the radius and ulna[(1)]. **Coleman et al.[(8)]** compared the quantitative leakage and showed that leakage under the tourniquet from forearm and upper arm was similar.

In our study, we used double cuff forearm tourniquet 3 cm above the radial styloid with lidocaine 1 mg/kg diluted in 10 ml with added fentanyl 12.5 μg diluted to 10 ml saline and we found that the start of sensory block was 3.5 minutes (2.5-5.5) with motor block started but with preserved motor power for the fingers and wrist. The main tourniquet time was 20.5 minutes with range of 10-28.5 minutes with nearly no intraoperative pain during the procedure. VAS was 1 during the procedure. Patients was haemodynamically stable during the operation with systolic and diastolic blood pressure compared with basal measurements before the start of anesthesia, 2nd day and follow up revealed no cases with wound infection, but after 10 days, there was one case with wound infection. Postoperative evaluation for patient satisfaction revealed that 13 patients from 20 patients were very satisfied and 5 patients satisfied and 2 cases somewhat satisfied .also, evaluation of surgeon satisfaction after the procedure revealed that the surgeon was very satisfied at 15 cases from 20 and satisfied at the remaining 5 cases. Follow-up for postoperative pain with VRS > 3 and 1st analgesic requirement was at 120 ± 15 minutes from the operation. **Nazem et al.[(1)]** found that the anesthesia onset time with prilocaine 1.5 mg/kg was 4.5 minutes. **Peng et al.[(10)]** reported 6.5 ± 2.9 minutes for lidocaine and 8 ± 4.1 minutes for ropivacaine group, and **Reuber et al.[(11)]** reported 13 ± 4 minutes for lidocaine and ketrolac in forearm IVRA when the tourniquet was applied 1 cm below the medial epicondyle. The difference in our study was that we used lidocaine with fentanyl with forearm IVRA with double tourniquet 3 cm above the radial styloid process. Numerous medications have been used to minimize the potential for systemic toxicity but the most reliable method appears to be minimizing the dose of local anesthetic and this can be achieved by forearm IVRA. The risks of dizziness, tinnitus and bradycardia are much lower with a forearm IVRA because local anesthetic dispersion with blood flow after tourniquet removal is much less. Forearm IVRA allows the dose of local anesthetic to be decreased by 50% without affecting the quality of analgesia, with much less postoperative pain[(12)].

Reuber et al.[(11)] stated that IVRA with forearm tourniquet provided an enhanced postoperative analgesic effect when compared with an upper arm tourniquet.

Distal forearm tourniquet is not popular in the clinical setting because it is too close to the surgical site, which may cause infection, but we did not observe infected cases after 24 hours of operation, but one case reported after 10 days. **Nazim et al. (1)** found no cases with wound infection with distal forearm IVRA.

CONCLUSION

We concluded that distal forearm IVRA with double cuff tourniquet placed 3 cm above the wrist, using lidocaine 1 mg/kg diluted to 10 ml saline, with added fentanyl 12.5 μg diluted to 10 ml normal saline provides safe, rapid onset and effective anesthesia for patients with outpatient hand surgery.

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استخدام الليدوكايين مع الفينتانيل في التخدير الوريدي الموضعي الطرفي للساعد

خلفية: التخدير عن طريق الحقن الوريدي الإقليمي واحدة من اكثرالطرق أماناً وأكثر اتساقا لإجراءات قصيرة على الطرف العلوي.

الأهداف: تقييم تركيبة ليدوكايين ١ مغ/كغ مع ١٢.٥ميكروغرام من الفنتانيل مع تورنيكويت٣ سم أعلي المعصم لإجراءات قصيرة لجراحة اليد.

المواد والطرق: ٢٠ مريضا المقرر لهم إجراءات قصيرة لجراحة اليد، مع محقن واحد على ظهر اليد لحقن الليدوكايين مع الفينتانيل ومحقن علي اليد الأخرى لضخ المحاليل خلال العملية. يتم اعطاء ليدوكائين ١ مغ/كغ تحلل في ١٠ مل محلول ملح مع١٢.٥ ميكروغرام من الفنتانيل تحلل في ١٠ مل محلول ملح تضخ على ٣٠ ثانية مع وضع تورنيكويت علي الساعد ٣ سم أعلي المعصم.

النتائج: فقد الاحساس بالالم بدأ بعد٣.٥ دقائق مع الحفاظ على قوة عضلات المعصم . حالة المرضي هايموديناميكالي مستقرة أثناء العملية مع ١٣ مريضا مرتاح جداً. أيضا، الجراح مرتاح جداً في ١٥ مريضا أثناء الإجراءات.

. الخلاصة:استخدام ليدوكايين مع الفنتانيل مع تورنيكويت علي الساعد الأعلى يعد اسلوبا آمنا مع بداية سريعة وفعالة للتخدير