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The Benefit of Infiltration Anesthesia Compares to Axillary Block Anesthesia for Arteriovenous Fistula Formation

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Abstract Arteriovenous fistula (AVF) is a vascular access for hemodialysis patients. This is a prospective clinical study to discover the benefit of axillary block anesthesia using lidocaine compared with infiltration anesthesia in radiocephalic fistula formation in the wrist. From July 1, 2013 to February 28, 2014, collected 130 patients using infiltration anesthesia categorized as Group-1, and another 130 patients using regional axillary block anesthesia categorized as Group-2. Group-1: lidocaine HCl 2% required per patient was in average 6.16 ml (123.2 mg lidocaine). Group-2: each patient required 15 ml. of lidocaine HCl 1.5% (225 mg lidocaine), and additional 3 ml lidocaine 2% (60 mg lidocaine) for 40 patients caused by less effective bloks. There was no serious operative complication or drug adverse reaction. The amount of lidocaine used for infiltration anesthesia significantly fewer in volume ($P<0.05$) when compared with axillary block anesthesia. AVF operation time was shorter in Group-1 compared with Group-2 ($P=0.60$), because the waiting time of anesthetic onset longer and often required additional lidocaine infiltration after axillary block. In conclusion, this study recommends to make radiocephalica surgery with anesthesia infiltration technique, because it is simpler, faster and less use of lidocaine.

Keywords: *arteriovenous fistula, end stage renal disease, axillary block anesthesia, infiltration anesthesia*

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1. Introduction

Arteriovenous fistula (AVF) or Brescia-Cimino fistula is a common operation to facilitate access for hemodialysis patients with End Stage Renal Disease (ESRD). AVF formation using lidocaine injection is often made in the wrist of the non-dominant upper extremity. Infiltration anesthesia and regional axillary block anesthesia has been known to help in reducing pain in AVF surgery by injecting lidocaine with a total volume as low as possible, because metabolit of lidocaine is excreted through the kidneys. Therefore, the amount of lidocaine use should be restricted to patients with renal failure [1,2,3]. This study was conducted to explain benefits of performing AVF formation using axillary block anesthesia.

2. Materials and Methods

This study was a prospective clinical trial of the effect of axillary block anesthesia for AVF formation in comparison with the infiltration anesthesia. AVF formations were done as radiocephalic anastomosis at wrist and or brachiocephalic anastomosis at cubital fossa, and all were done in left upper extremity using 7-0 polypropylene suture material.

Infiltration anesthesia was using lidocaine HCl 2% injection. Regional axillary block anesthesia was using Lidocaine HCl 1.5% and lidocaine HCl 2%.

All patients underwent AVF formation at the Hasan Sadikin Central General Hospital, in Bandung, Indonesia. The AVF formation performed by the same vascular surgeon (author) and consultant of regional anesthesia.

The operative procedure and infiltrative anesthesia were done by one vascular surgeon (the author). Regional axillary block anesthesia was done by a consultant of anesthesia.

Inclusion criteria were:

1. Radial artery and cephalic vein in the wrist area with diameter ≥2.0-3.0 mm were selected without thrombosis or calcification. Diameters were measured by a sterilized caliper.
2. Patients were men or women, aged from 20 to 65 years old with Body Mass Index (BMI) between 18 and 21, in the first month of weekly routine hemodialysis.
3. The operation performed by the same surgeon and anesthetist.
4. The AVF operation was the first surgery for the patient.

5. Patients with end stage renal failure needed to do chronic hemodialysis, not suffering diabetic mellitus type 1 or type 2.

6. Systolic blood pressure 120-160 mmHg.

7. Hemodialysis activity started less than 1 month.

Exclusion criteria were patients with shortness of breath (dyspnea), pulseless radial artery, vein with diameter < 2 mm, systolic blood pressure < 120 mmHg.

This study was conducted from July 1, 2013 to February 28, 2014, 130 patients (58 men and 72 women) were collected as Group-1 and AVF was made with infiltration anesthesia using lidocaine HCl 2%.

In Group-2, 130 patients (52 men and 78 women) were collected and regional axillary block anesthesia was done preoperatively.

A portable color ultrasound scanning device (SonoSite, Washington, USA) was used to detect the nerve site using a 23-G needle (Terumo, Philippines).

Axillary block anesthesia in upper left extremity needed 15 ml. Lidocaine HCl 1.5% for 60 to 80 minutes anesthesia in the wrist, and another 3 ml (45 mg) required additional injection of anesthetic infiltration at the site of surgery in 40 patients caused by less effective blocks. Skin incision can be made 30 minutes after regional anesthetic procedure. We recorded the requirement of Lidocaine HCl 2% for AVF formation and any complications or adverse reaction of anesthesia.

This study was approved by the institutional ethical clearance.

Statistical calculations using the t-test for normal distribution, or the binomial test for binomial distribution, using SPSS 18 for Windows. P value < 0.05 was considered statistically significant.

3. Results

In Group-1, each patient required in average 6.16 ml (123.2 mg) lidocaine HCl 2% for AVF formation on the wrist.

Table 1. Characteristics of samples within Groups

Characteristics (P=0.86)	Group-1 (n=130)	Group-2 (n=130)
Gender: Male	50	52
Female	72	78
Age: 20-30 years	2	2
31-40 years	3	2
41-50 years	57	61
51-60 years	35	45
61-65years	25	20
BMI: 18-19	75	70
BMI: 20-21	55	60

Table 2. Operation time of AVF formation at wrist

Operation time (minutes) Mean: 47.5 (SD 9.35)	Group-1 n=130	Group-2 (P=0.60) n=130
60	6 patients	4 patients
55	8 patients	5 patients
50	18 patients	11 patients
45	26 patients	47 patients
40	34 patients	39 patients
35	38 patients	24 patients

Operation time ≤ 45 minutes in Group-1 was 98 patients, Group-2 was 110 patients (P=0.15). Operation time >45 and ≤ 60 minutes in Group-1 was 32 patients, Group-2 was 20 patients (P=0.28)

Table 3. Lidocaine HCl used in Groups

	Group-1 (n=130)	Group-2* (n=130)
Radiocephalic anastomotic area	Wrist	Wrist
Lidocaine HCl 2% **	6.16 ml. (123.2 mg)	0
Lidocaine HCl 1.5% ***	-	15 ml (225 mg)
Lidocaine HCl in average (mg)	123.2 mg (P<0.05)	225 mg

* In 40 patients required 3 ml lidocaine 2% to be injected at the wrist, because the axillary blocks were less effective. **In 1 ml of Lidocaine HCl 2% has 20 mg Lidocaine HCl. ***In 1 ml of Lidocaine HCl 1.5% has 15 mg Lidocaine HCl. Group-1: the maximal dosage Lidocaine HCL 2% dosage was 9 ml. Group-2: the maximal dosage was 15 ml Lidocaine HCl 1.5% and 3 ml Lidocaine HCl 2%.

There were not any serious complications encountered caused by lidocaine, only 2 patients with trivial pain at the injection site, which then disappeared in less than 1 week. Postoperative edema at the wrist was seen in only 4 patients, which later disappeared within a few days.

Each patient in Group-2 required only 15 ml of lidocaine HCl 1.5%.

The operation time or duration of surgery in Group-1 was longer because they usually need 15 minutes and 30 minutes in Group-2 for the anesthetic action before performing the incision. The infiltration anesthesia caused 50 minutes of analgesia without postoperative muscle weakness. The axillary block anesthesia can cause effective analgesia for 90 minutes, weakness of skeletal muscle movements for the next 2 hours. The patients were treated with postoperative care for a maximum of 3 hours in the recovery room, then they were discharged.

In 25 patients of Group-1 and 29 patients of Group-2 a small volume of lidocaine 2% (2-3 ml) needs to be added and injected to the wound, and these patients required a longer operating time for many reasons, such as the difficulty to stop the bleeding leak at the anastomosis or a broken branch of a small vein in the cephalic or cubital vein, or ligation of the bleeding points in the vascular bed.

In Group-1 dilated cephalic veins were clearly seen in 52 patients, and 61 patients in Group-2 (P>0.05).

4. Discussion

The dilated veins were more often in Group-2 than in Group-1, but the difference is not significant and this results is according the literatures, [4-8]. Vasodilation that occurs due to anesthesia can help to maintain a high rate of blood flow in the AVF both intraoperatively and postoperatively [7,8]. According to the research from Sahin et al. the dilated cephalic veins is also experienced by the radial artery, and the dilatation causes increased radiocephalic flow rate [7]. Peripheral vascular dilatation caused by sympathetic block of preganglionic fibers [9]. The dilatation of the veins make it easier to be found and also facilitates the anastomosis formation and shortening of operation time, and as a consequence it may reduce the occurrence of difficulties, error and failure in surgery.

Four weeks postoperative failure in Group-2 are fewer than in Group-1 although it is not significant, this results confirm the advantage of postoperative vessels dilatation [5,6,7].

The result of shortening the duration of the operation is the reduced use of lidocaine HCl 2%.

The advantages of infiltration block anesthesia is simple, faster, low cost, very useful for small surgical procedures. The disadvantages of infiltration anesthesia is limited efficacy, short duration of action, potential for adverse local toxic effects. The advantages of axillary block anesthesia is commonly performed due to its ease of performance and relatively high success rate using ultrasonography [9]. The disadvantages of the axillary block include inadequate anesthesia in the distribution of the musculocutaneous nerve and medial antebrachial cutaneous nerve [9]. This nerve supplies the flexor and extensor muscles and its branch supplies sensation to the skin of the forearm. If these nerves are missed, it may be necessary to block this nerve separately [9}. In this study all procedures of infiltration anesthesia and axillary block anesthesia carried by experts in these fields who have been doing the procedures for more than 10 years, therefore make the procedures safely done. These procedures are based on standard operation procedure of our hospital.

The use of ultrasound makes lidocaine doses smaller, but efficient. However on 40 radiocephalic formations should add more 2% lidocaine injection, to increase the ability of anesthesia. It has been known that the axillary block anesthesia is reliable in anesthetizing the radial, median and ulnar nerves of the hand, but it is a volume dependent (individual variation). The musculocutaneous nerve and the medial antebrachial cutaneous nerve and their sensory distribution in the forearm can be spared because these nerves depart from the perivascular bundle high in the axilla [9]. Thus requiring additional 2% lidocaine injection in the wrist area [9].

The duration of the operation using infiltration anesthesia showed a shorter time of AVF formation, therefore more beneficial in terms of not requiring additional volume of lidocaine, the patient also spent a shorter amount of time lying on his back and felt less anxiety. Some patients felt soreness and dyspnea while lying down, therefore with the shorten operative time would be more favorable to patients with anxiety and shortness of breath whom only able to sit in half sitting position, and in young patients (younger than 30) who often could not wait for long.

The results of this study provide advice in doing radiocephalic formation sufficiently assisted with infiltration anesthesia. The use of lidocaine for infiltration anesthesia significantly fewer in volume when compared with axillary block anesthesia, and the procedure of axillary block anesthesia was more time consuming. In conclusion, this study recommends to make radiocephalica fistula using anesthesia infiltration technique, because it is simpler, faster and less use of lidocaine.

Conflict of Interest/Funding

None.

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