Combined Infraclavicular and Axillary Brachial Plexus Block for Arteriovenous Shunts Using Graft: A Comparison Study

Jamal Abdelaziz MD, Ibrahim Khasawneh MD**

ABSTRACT

Objectives: This study was conducted to evaluate the extent and efficacy of combining infraclavicular and axillary brachial plexus block for arteriovenous shunt using graft versus performing each mentioned block alone.

Methods: Eighty-two ASA III and IV patients were allocated randomly to receive either true axillary block (Hirshels' technique) (group I, 26 patients), or Infraclavicular block (group II, 28 patients), or combined Infraclavicular and Hirshels' axillary block (group III, 28 patients). All patients received 40-50ml bupivacaine 0.375%. The extent and efficacy of anesthesia (nerve gaps) complications and duration of analgesia of all groups were recorded and analyzed.

Results: The three groups were comparable according to age, gender and weight. The duration of operations was 105±15 minutes, and 18-20 minutes after the completion of block all patients in the three groups demonstrated sufficient surgical anesthesia. Five patients from group I, three patients from group II and two patients from group III needed supplementation with xylocaine subcutaneously or with intravenous analgesics and sedatives (fentanyl 50mcg, ketamine 10-50mg with midazolam 1-2mg) during incisions of lateral aspect of arm or forearm (musculocutaneous and radial nerve distribution or intercostobrachial nerves distribution). Blood taps were recorded in three patients from group I. However, the combined group showed superior anesthesia regarding the three previously mentioned nerves compared with the single site blocks.

Conclusion: Combined infraclavicular and axillary block anesthesia demonstrates an extensive sensory and motor block in comparison with performing the same blocks individually.

Key words: Axillary block, Brachial plexus block, Combined infraclavicular block

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Introduction

Operations performed for arteriovenous shunting using grafts take place at the inner aspect of the arm, elbow, forearm and axillary region. The sensory supply of these regions is provided from the intercostobrachial nerves (T1-T3) and medial cutaneous nerves of the arm and forearm. Graft insertion, looping and tunneling are carried out with small incisions at the mediolateral aspect of the arm and forearm (Fig. 1). This region is supplied entirely by branches of the musculocutaneous and radial nerves. Numerous techniques are now available to block the brachial plexus along its course. Infraclavicular and axillary approach would block brachial plexus where all cords and most of its branches are at close proximity. Several studies have been performed in the recent years to

*From the Department of Anesthesia and Intensive Care, King Hussein Medical Center, (KHMC), Amman-Jordan
Correspondence should be addressed to Dr. J. Abdelaziz, P. O. Box 65144 Zarqa 13115 Jordan
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investigate and compare the efficacy of different single site blocking procedures but success rate varies widely.[1-20] A major way to improve the success rate has been to locate and separately block each nerve along its course which is time consuming in a busy day case surgery department.[1,5,10]

Infraclavicular brachial plexus block (ICB) has been shown to be frequently successful while using a single–stimulation technique.[2-4] The stimulation should be targeted to the musculocutaneous, median or radial nerve at the level of the cord before these nerves leave the brachial plexus, however, the incidence of complete paralysis and complete anesthesia of the upper limb was low in some studies[3] and good in other studies.[4] Whereas, true axillary approach is more successful in blocking the intercostobrachial nerves and medial cutaneous nerves, it requires 3-4 stimulations to obtain a high success rate.[5,6] The block needle should be inserted high enough in the axilla (in close proximity to musculocutaneous nerve), to block the musculocutaneous nerve which frequently is missed.[7]

We hypothesized that combining ICB and true axillary block together would have equally efficient dissemination of the anesthesia (radial and musculocutaneous nerves, medial cutaneous nerves and intercostobrachial nerves) and better block effectiveness.

Methods

Institutional approval and informed written consent was been obtained from 82 patients (ASA II, III and IV) who were scheduled for arteriovenous shunt (AVF) using graft under brachial plexus block anesthesia. Patients with coagulation profile abnormalities, previous clavicular fractures or chest abnormalities, venous dilatation and hypertension of the upper arm, and those who refused to participate were excluded from the study.

The study patients were randomly divided into three groups: Group I (n=26) was scheduled to receive true axillary approach for brachial plexus block according to Hirshels' method, group II (n=28) was scheduled to receive infraclavicular block and group III (n=28) was scheduled to receive both blocks as described previously. The volume of the local anesthetics was halved between the two blocks.

During Hirshels' method the patient lies in supine position, the arm to be blocked is abducted 90° at the most and is positioned on a cushioned surface (*e.g.* arm table) in a relaxed manner. The course of the axillary artery of the medial upper arm can be palpated dorsal from the medial bicipital groove. The puncture site is located slightly above the axillary artery, at the highest point in axilla and slightly beneath the pectoralis major muscle, which borders the axilla ventrally. After disinfection and local anaesthesia of the puncture site with 1% xylocaine, the stimulation needle is inserted parallel to the axillary artery at a 30° angle to the skin. Contractions are sought in the area of the median nerve, or even better, of the radial nerve. Once the threshold current is reached, 40-50 ml of the local anesthetic (bupivacaine 0.375%) is injected (Fig. 2). During injection, pressure distal to the injection point helps the local anesthetic to cephalad migrate up in the axilla.

In the infraclavicular approach the patient is positioned in supine position, with the hand of the side to be blocked positioned on the abdomen. The puncture site is located at the halfway point between the ventral apophysis of the acromion and the jugular fossa. After disinfection and local anaesthesia of the puncture site with 1% xylocaine, the stimulation needle is inserted directly beneath the clavicle and in a strictly vertical direction. Usually, at this site, after reaching a desired depth, the primary segments of the lateral cord (contractions of the biceps brachii muscle) are stimulated, then the needle is redirected until the desired motor response (the peripheral contractions of the finger muscles: extensors or flexors D I-III, *i.e.,* muscles supplied by the radial or median nerve) is achieved. Once the threshold current is reached, 40-50 ml (up to 3mg/kg of maximum dose) of local anesthetic (bupivacaine 0.375%) is injected (Fig. 3).

All blocks were performed using contiplex insulated needles, 50mm, 22 gauge and nerve stimulator (Digistem 3 Plus, Organon Teknika). The local anesthetic was injected after we sought a distal and clear motor response in the hand or wrist with stimulating intensity ranging between 0.5 and 0.3 mA. The procedure duration was measured from the needle insertion to withdrawal. Disinfection, toweling and other preparations were not considered as part of procedure duration. The same senior anesthetist performed all blocks.

Another senior anesthetist, tested the patients for sensory and motor block, the test was carried out every five minutes for 25 minutes, a successful

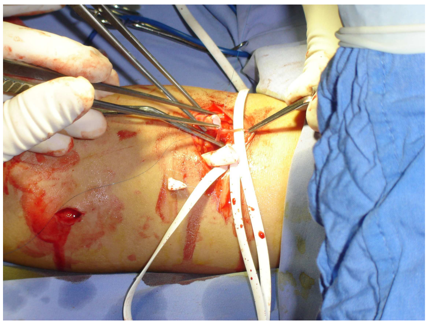

Fig. 1. Incision, tunneling and looping site

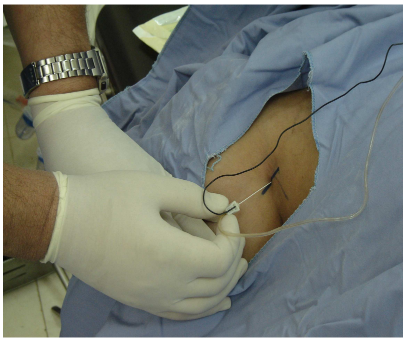

Fig. 2. Axillary nerve block –Puncture site and technique

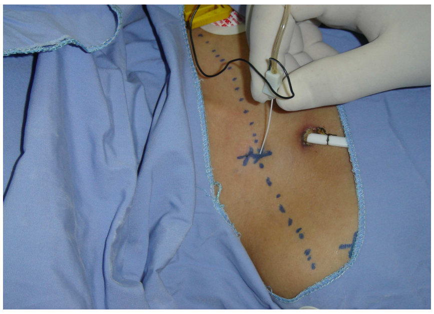

Fig. 3. ICB- Puncture Site and Technique

Table I. Patients and Surgical Data

	Group I (Axillary block)	Group II (ICB)	Group III (Combined block)
Gender (M/F)	10/16	12/16	12/16
ASA (II/III/IV)	5/12/7	8/11/9	8/13/7
Age (Years± SD)	36.4±7.2	38.8±4.8	37.2±5.6
Weight (Kg)	72.7±6.8	69.8±5.7	73.5±5.921
Type of Surgery			
Forearm Graft	7	8	9
Bracheo-Axillary Graft	10	11	10
Bracheo-Brachial Graft	2	1	1
Cubital Fossa Fistula	3	4	3
Basilic Vein Transposition	2	1	2
Axillo-axillary Graft	2	3	3

block was defined as the absence of cold and pinprick response in the distribution of the musculocutaneous, radial, medial cutaneous nerves, median and ulnar nerves (0 = no sensation to 2 = normal sensation).

The motor block was assessed with a scale from 0 to 5 (0 = complete paralysis to 5 = normal muscular force). If sensory gaps were present at 20 minutes from the time of needle withdrawal (completion of block procedure), the surgeon was informed to add local subcutaneous anesthetic at the site if needed, and or we considered the addition of analgesics and sedatives (fentanyl 50 mcg, ketamine 10-50 mg with midazolam 1-2 mg) intravenously.

Venous and/or arterial puncture, complications from overdose and/or inadverant intravenous local anesthetics, such as convulsion, arrhythmia or pneumothorax were recorded. Further follow up for late complications such as paresthesia or prolonged nerve injury, pain, infection or retrospective bad experience from anesthesia or surgery was carried out by the surgeon using a Liker scale ranging from 0=no satisfaction to 5=very satisfied.

Statistical analysis was performed descriptively using means, standard deviations and frequencies. The Chi-square statistical test was used for bivariate analysis. The level of significance was set at P>0.05.

Results

All groups were comparable in relations to age weight and gender. Table I shows all groups demographic and surgical data.

The time to perform the ICB (group II) block was significantly shorter (3.6±1.4 min) than the two other groups (5.2 ±1.3, P<0,001 for group I and 6.3 ± 1.6, P<0.001 for group III).

The onset time was almost similar for the three groups. It was 18.9 minutes for group I, 19.8 minutes for group II, and 18.3 minutes for group III.

The success rate was 80.7% for group I, 89.28% for group II and 92.8% for group III. Five patients of group I complained of pain sensation from incision at lateral or mediolateral aspect of the arm; supplementation of xylocaine was done by the surgeon at the site of incision. Two of these patients needed extra supplementation of analgesics and sedatives during the procedure. Three patients of group II required supplementation of xylocaine at the incision site and intravenous analgesics and sedatives at the beginning of the procedure, later on no analgesics nor xylocaine subcutaneously were needed.

Two patients of group III complained of pain sensation at the beginning of operations, the addition of 10-50mg ketamine with 1-2mg midazolam intravenously appear to be sufficient to continue the procedure with no further complaints.

Blood tap (venous or arterial puncture) was recorded in two patients of group I and two other patients in group III with no clinical consequences. No clinical consequences from vascular absorption or overdose of local anesthetics were observed in all groups.

A high degree of satisfaction was recorded in 96.4% of group III versus 88.4% of group I and 92.8% of group II.

Discussion

In this study we report the efficacy of combining infraclavicular and axillary plexus block by single elctrostimulation for each block. The combination method in our study led to a high degree of satisfaction. In our technique, a single stimulation is required for each block, which led to high success rate for blocking the musculocutaneous, intercostobrachial and medial nerves of the arm and forearm in addition to the other nerves (radial, median and ulnar) forming the brachial plexus.

The reported success of axillary block alone by single elctrostimulation varies widely (43-85%),[8-10] this may be explained by the difficulty of identifying and blocking the musculocutaneous nerve, which leaves the plexus high in the axilla. In the axillary block, despite the higher success rate from multiple stimulations technique, withdrawal and redirection of the stimulating needle to elicit the different muscular twitches increases the patients' discomfort and the mean time to perform the block, as well as it causes a more vascular puncture.[8,9]

Many studies comparing single elctrostimulation ICB with single stimulation axillary block, suggest a higher success rate (97-100% *vs.* 80-85%)[2,11,12] possibly due to better blockade of the radial and musculocutaneous nerves, however, Borgeat, reported a success rate of 44% when a proximal motor response was accepted for local anesthetic injection.[13,14] In order to increase the success rate, many authors advocated a dual or triple stimulation technique; however, while this method increases the success rate, the time needed for its performance was slightly greater (9±3 minutes).

In our study, we have found that there was no significant difference in success rate in multiple stimulation axillary block (92.8% *vs.* 93%, $P \leq 0,005$)[10,17] or dual stimulation infraclavicular block (92.8% *vs.* 92%, $P \leq 0.005$).[17,18] The mean performance time was also similar for dual stimulation infraclavicular block (6.3 *vs.* 4.5-6.2 minutes, $P \leq 0.005$),[14,17] and significantly less than performing quadruple axillary block (6.3 *vs.* 8.4- 9.8 minutes, $P \geq 0.05$).[9,10,17] However, because of the reduced number of needle stimulations and injections, combining both blocks resulted in greater patient satisfaction and fewer side effects such as arterial and venous puncture.[5,10,19] In addition, Orlowski and his colleagues,[20] using high resolution scanning, were able to demonstrate contrast leakage outside the brachial plexus sheath along the chest wall once a volume of 20ml or more contrast medium had been injected in cadavers in the supine position. Therefore, we assumed that by dividing the local anesthetic volume in two a site block may reduce the leakage volume, which may results in a better success rate and better dissemination of the local anesthetics along the brachial plexus course.

Conclusion

Combining both single stimulation axillary block and infraclavicular block is simple, very effective, has a high success rate with few side effects, and is very well tolerated by patients.

References

1. **Lavoie J, Martin R, Tetrault JP, Cote DJ, Colas MJ.** Axillary plexus block using a peripheral nerve stimulator: single or multiple injections. *Can J Anesth* 1992; 39: 583-6.
2. **Kapral S, Jandarasits O, Schabenig C, *et al.***

Lateral Infraclavicular plxus block versus axillary block for hand and forearm surgery. *Acta Anesthesiol Scand* 1999; 43:1047-52.

3. **Bloc S,Garnier T, Komly B, *et al*.** Single-stimulation low- volume Infraclavicular plexus block: influence of evoked response on success rate. *Reg Anesth Pain Med* 2006; 31: 433-7.
4. **Lecamwasam H, Mayfield J, Rosow I, *et al*.** Stimulation of the posterior cord predicts successful Infraclavicular block. *Anesth Analg* 2006; 102; 1564-8.
5. **Koscielniak-Nielsen ZJ, Hesselbjerg I, Fejlberg V**. Comparison of transarterial and multiple nerve stimulators for an initial axillary block by 45 ml of mepivacaine 1% with adrenaline. *Acta Anesthesiol Scand* 1998; 42: 570-5.
6. **Handoll HH, Koscielniak-Nielsen ZJ.** Single, double, or multiple injection techniques for axillary brachial plexus block for hand, wrist or forearm surgery. *Cochrane Database Syst Rev* 2006; 1CD003842.
7. **Youssef MS, Desgrand DA.** Comparison of two methods of axillary brachial plexus anesthesia. *Br J Anesthesia* 1988; 60: 841-4.
8. **Fanelli G, Casati A, Garancini P, Torri G.** Nerve stimulator and multiple injection technique for upper and lower limb blockade; failure rate, patients acceptance, and neurological complications. *Anesth Analg* 1999; 88: 847-52.
9. **Sia S, Lepri A, Campolo MC, Fiaschi R.** Four-injection brachial plexus block using peripheral nerve stimulator: a comparison between axillary and humeral approaches. *Anesth Analg* 2002; 95: 1075-9.
10. **Lavie J, Martin R, Tetralaut JP, Cote DJ, Colas MJ.** Axillary plexus block using peripheral nerve stimulator: single or multiple injections. *Eur J Anesthesiol* 1997; 14:164-71.
11. **Rettig HC, Gielen JM, Boerma E, Klein J.** A comparison of the vertical Infraclavicular and axillary approaches for brachial plexus anesthesia. *Acta Anesthesiol Scand* 2005; 49:1501-8.
12. **Heid FM, Jage J, Guth M Bauer N, Brambrink AM.** Efficacy of vertical Infraclavicular plexus block vs. modified axillary plexus block: a prospective, randomized, observer-blinded study. *Acta Anesthesiol Scand* 2005; 49: 677-82.
13. **Borgeat A, Ekatodramis G, Dumont C.** An evaluation of the Infraclavicular block via a modified approach of the Raj technique. *Anesth Analg* 2001; 93: 436-41.
14. **Gaertner E, Estebe JP, Zamfir A, Cuby C, Macaire P.** Infraclavicular plexus block: multiple injections versus single injection. *Reg Anesth Pain Med* 2002; 27:590-4.
15. **Rodriguez J, Barcena M, lagunilla J, Alvarez J.** Increased success rate with Infraclavicular brachial plexus block using a dual- injection technique. *J Clin Anesthesiol* 2004; 16: 251-6.
16. **Rodriguez J, Tabonda M, DelRio S, Barcena M, Alvarez J.** A comparison of four stimulation pattern in axillary block. *Reg Anesth Pain Med* 2005; 30: 324-8.
17. **Minville V, Amathieu R, Luc N, *et al*.** Infraclavicular brachial plexus versus humeral approach: comparison of anesthetic time and efficacy. *Anesth Analg* 2005; 101:1198-201.
18. **Minville V, Fourcade O, Idabouk I, *et al*.** Infraclavicular brachial plexus block versus humeral canal block in trauma patients: a comparison of patient discomfort. *Anesth Analg* 2006; 102: 912-5.
19. **Koscielniak-Nielsen ZJ, Rotboll Nielsen P, Risby Mortensen C.** A comparison of coracoid and axillary approach to the brachial plexus. *Acta Anesthesiol Scand* 2000; 44: 274-9.
20. **Orlowski O, Bullmann V, Vieth V, *et al*.** Perivascular axillar brachial plexus block and patient positioning: the influence of the lateral, head-down position. *Anesthesia* 2006; 61: 528-35.