

Short Term Outcome of Brachial Plexus Block in Vascular Access Surgery

Mamoun Al-Basheer MD, Ahed Aledwan MD**, Mohammed Kilani MD**,
Jan Shishani MD*, Maleeha Jalamdeh RN^*

ABSTRACT

Objective: To present short term outcome of brachial plexus block for upper limb vascular access procedures performed for renal dialysis.

Methods: This is a retrospective review of all cases that had a brachial plexus block for a renal dialysis vascular access procedure at the vascular surgery unit in King Hussein Medical Center, Amman, Jordan, between January 2009 and September 2011. Two hundred eighty-eight patients (172 males, 116 females) with a mean age of 41 (19-68) years had the block. In 183 (63.5%) patients the procedure was primary and in 75 (26.0 %) patients it was native access. Procedures performed included: 27 (9.4%) brachio-cephalic arteriovenous fistula, 48 (16.7%) basilic vein transposition, 96 (33.3%) forearm prosthetic loop graft, 67 (23.3%) upper arm prosthetic loop graft, 25 (8.7%) salvage procedures with interposition prosthetic grafts, 14 (4.9%) removal of infected prosthetic grafts, and 11 (3.8%) repairs of false aneurysms and disrupted anastomoses. All blocks were guided by a nerve stimulator at strength of 0.2-0.5MHZ and Bupivacaine 0.375 (25-35 ml) used for the block. Supraclavicular block was used in 132 (45.8%) patients while combined supraclavicular and axillary blocks were used in 156 (54.2%) patients. When local anesthetic infiltration was needed for supplementation of the block, Lignocaine 1% (10-15 ml) was used. Data regarding the procedure, adequacy of the block, time of onset, duration of block, and immediate complications was retrospectively collected from anesthetic charts and operative records.

Results: All patients had an adequate block with no conversions to general anesthesia or cancellation of the procedure. A successful block was achieved in 232 (80.6%) patients while a partially successful block was achieved in 56 (19.4%) patients. The median time for onset of the block was 10 (5-20) minutes for motor block and 15 (10-35) minutes for sensory block. The mean duration of the block was 5.6 (2.2-48.0) hours. Prolonged blocks beyond 24 hours occurred in 5 patients (48 hours in 1 patient, 36 hours in 1 patient, and 24 hours in 3 patients). Injection related complications included discomfort during injection in 100 (34.7%) patients and local hematomas relieved by compression in 8 (2.8%) patients). Transient nerve paralysis complicated 82 (28.5%) cases (phrenic nerve in 57 (19.8%) patients, sympathetic chain resulting in Horner's syndrome in 20 (6.9%) patients and vagus nerve resulting in hoarseness of voice in 5 (1.7%) patients). No clinically detectable pneumothorax or drug toxicity occurred. No peri-operative mortality was reported during the study period.

Conclusions: Brachial plexus block is an effective and safe mode of anesthesia for upper limb renal dialysis vascular access procedures. It offers major advantages over general anesthesia and enjoys low rate of failure and complications. Its use as a main mode of anesthesia for such procedures is advisable.

Key words: Outcome, Brachial plexus block, Vascular access.

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From the Departments of:

*Surgery, Vascular Surgery Unit, King Hussein Medical Center, (KHMC) Amman, Jordan

**Nursing, KHMC

Correspondence should be addressed to. Dr M. Al-Basheer, KHMC, E-mail: Drbasheer30@yahoo.com

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Introduction

Patients with chronic renal failure are a high-risk group for general anesthesia because of the concomitant diseases with coronary artery disease, diabetes mellitus and hypertension.^(1,2)

Three anesthetic techniques are commonly used for vascular access surgery: monitored local anesthesia care, regional anesthesia, and general anesthesia. Regional anesthesia avoids the side effects of general anesthesia, bypasses the stress of induction, and avoids the hemodynamic disturbances seen in general anesthesia patients with severe co-morbidities.⁽³⁾ Brachial plexus block (BPB) is the more advantageous or effective choice in creating a vascular access for hemodialysis. The simplicity and the low risk of serious complications accounts for its common usage.^(2,4) BPB also provides better postoperative analgesia and faster recovery from anesthetic drug effects. There are, however, risks with this technique, including unintentional damage to the surrounding anatomy, neuropathy from nerve injury, hematoma, infection, and injection of local anesthetic in vessels leading to central nervous system and cardiac toxicity. There also can be a longer latency between administration and anesthesia, and a small failure rate between 1% and 3% depending on the experience of the operator.^(3,5) We report our experience in this area with emphasis on short term outcome and complications.

Methods

Between January 2009 and September 2011, 288 patients (172 males, 116 females) with a mean age of 41 (19-68) years, underwent upper limb vascular access for renal dialysis procedures under Brachial Plexus Block (BPB) at the vascular surgery unit in King Hussein Medical Center, Amman, Jordan.

All patients had chronic renal failure and were appropriately referred by nephrologists for vascular access. One hundred ninety-one (66.3%) patients were American Society of Anesthesia (ASA) class-3 while the rest were ASA class-2. In 183 (63.5%) patients the procedure was primary (i.e. first time creation of access at that site) and in 75 (26.0 %) it was native (i.e. patient's own vessels used for access

creation) hemodialysis access. The procedures performed under BPB are shown in Table I.

Table I: Procedures performed under BPB.

Procedure	Number	%
Brachio-cephalic arteriovenous fistula	27	9.4
Basilic vein transposition	48	16.7
Forearm prosthetic loop graft	96	33.3
Upper arm prosthetic loop graft	67	23.3
Removal of infected graft	14	4.9
Interposition prosthetic graft	25	8.7
Repair of false aneurysm/ disrupted anastomosis	11	3.8

All blocks were guided by a nerve stimulator. Supraclavicular block was used in 132 (45.8%) patients while a combined supraclavicular and axillary block was used in 156 (54.2%) patients.

The technique of the block was uniform and involved localization of the brachial plexus by nerve stimulator set at 0.2 to 0.5 MHZ using a 22-gauge stimulating needle after landmarks used to identify were the needle to be inserted. The main landmarks for this block are the lateral insertion of the sternocleidomastoid muscle in the clavicle, the clavicle itself and the midline of the patient. These three landmarks are easily identifiable in the majority of patients. Our technique is a single-injection, nerve-stimulator technique. The block is performed with the patient in a semi-sitting position with the head rotated to the opposite side. The semi-sitting position is more comfortable than the supine position both for the patient and the operator. The patient is asked to lower the shoulder and flex the elbow, so the forearm rests on his/her lap. The wrist is supinated so the palm of the hand faces the patient's face. This maneuver allows for detection of any subtle finger movement produced by nerve stimulation. If the patient cannot turn the wrist on supination a roll is placed under it so the fingers are free to move. The supraclavicular block is achieved by injection of 25-35ml of Bupivacaine 0.375%. When combined axillary and supraclavicular block was used, the supraclavicular region was injected with 25-35ml of 0.375 Bupivacaine and the axillary with 15ml 0.375 Bupivacaine.

Table II: Main complications of BBP

Category	Complication	Number	%	Outcome
Injection related	Discomfort	100	34.7	Resolved
	Local hematoma	8	2.8	Relieved by compression
Side effects (Transient nerve paralysis)	Phrenic nerve	57	19.8	Resolved
	Sympathetic chain	20	6.9	Horner's syndrome
	Vagus nerve	5	1.7	Hoarseness of voice

When local anesthetic infiltration was needed for supplementation of the block, Lignocaine 1% (10-15ml) was used. All patients received 50 mcg of Fentanyl and 1-2mg Midazolam, as sedation before commencing the block and anxious patients were supplemented by another 50 mcg of Fentanyl and 1mg of Midazolam during surgery. Continuous monitoring of heart rate, blood pressure, and electrocardiographic trace was instituted throughout. The adequacy of the block was evaluated at 5 minute intervals after injection of local anesthetic. Time of onset of the block was determined using the "finger to nose" test as an indication of decreased fine motor control and/or loss of proprioception. Sensory blockade was tested using a needle brick test and graded as normal sensation, dull, or no sensation. All patients with dull sensation had local anesthetic infiltration prior to incision. All those who tolerated the procedure without the need to conversion to general anesthesia or cancellation of the procedure were considered to have an adequate block. All patients who required supplementation with local anesthetic infiltration were considered to have partially successful block. The block is considered successful in the rest. The primary endpoints of the study were: adequacy of the block, time of onset, and duration of blockade. The secondary endpoints were immediate complications. All data was retrospectively collected from anesthetic charts and operative records. Results are summarized as means and range for continuous variables while categorical data are summarized as counts or percentages.

Results

Out of 288 procedures done during the study period, 246 (85.4%) resulted in establishing a functioning access procedure upon patient discharge from hospital. The median time for onset of the block was 10 (5-20) minutes for motor block and 15 (10-35) minutes for sensory

block. The mean duration of the block was 5.6 (2.2-48.0) hours. Prolonged blocks beyond 24 hours occurred in five patients (48 hours in 1 patient, 36 hours in 1 patient, and 24 hours in 3 patients). The BPB was completed in all patients and all had an adequate block with no conversions to GA, while 232 (80.6%) had a successful block as defined in methods previously. The block was supplemented by local anesthetic (Lignocaine 1%, 10-15 ml) infiltration in 56 (19.4%) patients who were considered to have partially successful block.

The main complications of the block are shown in Table II. Of note is the transient nature of all nerve injuries which occurred in 82 (28.5%) cases. No clinically detectable pneumothorax or drug toxicity occurred.

Out of 67 (23.3%) patients who needed post operative admission, five (1.7%) patients with prolonged blocks needed overnight admission related to the block. The rest had an access procedure related admission. No perioperative mortality was reported during the study period.

The type of access was changed following the block in 18 (6.3%) patients who were originally planned for prosthetic loop graft and ended in native access (13 (4.5%) brachiocephalic arteriovenous fistulas and five (1.7%) basilic vein transposition).

Discussion

Arteriovenous Access (AVA) for hemodialysis has been the mainstay of survival for patients with end stage renal failure ever since the publication of the first description of autogenous AVA by Brescia, Cimino, Appel and Hurwich (1966) that irrevocably altered the management of end-stage renal disease patients. Autogenous AVA is the preferred access for hemodialysis, while prosthetic AVA is the alternative in patients for whom autogenous AVA is not feasible.⁽⁶⁾ BPB is a preferred method of anesthesia in our unit when a prosthetic AVA,

transposition, long, or extensive procedure is planned. In essence we use it for all upper limb access procedures except in cases of straight forward arteriovenous autogenous fistula where local anesthetic infiltration is used. This block has many advantages, the main ones being prolonged duration of action and absence of systemic effects of general anesthesia agents, which safely allows prolonged surgical interventions, while the need for postoperative analgesia is significantly reduced.⁽⁷⁾ An additional benefit is that BPB commonly blocks the musculocutaneous nerve and the medial cutaneous nerve of the forearm with infiltration of local anesthetic outside the axillary sheath, and so minimizes the need for strategies that involve vessel handling to achieve hemostasis by allowing the use of an above elbow tourniquet.^(6,7) Other possible benefits of regional anesthesia are avoidance of hemodynamic instability and stress response of general anesthesia, excellent postoperative analgesia, and the addition of a motor block (compared with local anesthesia). Some authors have suggested that the venodilatation that occurs with regional anesthesia may also facilitate more available options for placement of the AVF.⁽⁸⁾ The main drawbacks are the complications discussed below, the extra time needed for placement and for the block to function, and the need for a dedicated experienced operator for best outcome. An unusual warning area recently reported is the potential for the block to mask or delay the diagnosis of arm ischemia because of its prolonged effective analgesic and motor loss effects.⁽⁹⁾ Different BPB approaches are used, each of which provides a characteristic anatomic pattern of anesthesia. The most commonly used approaches in BPB for access surgery are the supraclavicular, axillary (AXB), and infraclavicular ones. For example, supraclavicular block anesthetizes middle and lower plexus nerves over 80% of the time (median, radial, and ulnar) while AXB successfully anesthetizes distal terminal branches, spares the supraclavicular and axillary nerves, and variably blocks the musculocutaneous nerve. Although it may seem logical that these patterns are linked to the successful provision of clinical anesthesia for access surgical procedures, the impact of

approach has not been prospectively studied in a reliable manner. The infraclavicular approach is used less but is equally effective.^(10,11) Although our data was retrospectively collected, the technique of the block was uniform as all blocks were performed by a single operator while the vascular access procedures were performed by multiple operators. A comparative analysis between these different approaches is beyond the scope of this discussion, however we do find the supraclavicular approach combined with an AXB when needed effective in providing adequate BPB in most cases. The use of electrical stimulation to locate peripheral nerves was introduced in 1962. Several advantages have been reported with this technique, including a higher success rate, the ability to perform procedures on sedated or uncooperative patients, the avoidance of vascular injury, and the avoidance of paresthesias and associated neurologic injury.^(6,7,11) Another adjuvant tool is the use of ultrasonography which was not available to us during the study period; however we have started doing the blocks under ultrasound guidance only recently and hope it will further improve our outcome.

There are many potential complications and side effects of BPB, the incidence of which is variable with the approach used and the experience of the operator. Significant reported complications include peripheral nerve injuries, cardiovascular, respiratory and central nervous system complications.⁽¹²⁾ In our study, the most prevalent side effect was peripheral nerve paralysis which affected 28.5% of cases, none of which was permanent. We noticeably had no clinically apparent pneumothorax or drug toxicity complications. We do not do routine chest X-rays post procedure as we do not find them cost effective which makes it possible that some minor pneumothorax cases are missed. Such complication is usually treated conservatively even if diagnosed post operatively. The bleeding risk associated with plexus and peripheral nerve block techniques with or without concomitant use of anticoagulants remains undefined. Intuitively, if bleeding occurs in a space that can expand, such as muscle or subcutaneous tissue, bleeding or hematoma should not result in permanent neurological deficits. If the bleeding occurs in a closed facial compartment, then there

is a potential for neurological injury. Even in the event of neurological injury, it will be unilateral compared with paraplegia that results from neuraxial hematoma. However, there are case reports on severe bleeding complications after peripheral nerve blocks under the influence of anticoagulants.^(12,13) Perioperative nerve injury has long been recognized as a complication of brachial plexus blockade, with a frequency ranging from 0.2% to 19%. The creation of vascular access for chronic hemodialysis may also be associated with significant neurological injury. Prompt recognition of reversible etiologies, in all cases of neurological injury, is essential to improve outcome. The presence of residual neural block after regional anesthesia, however, may delay diagnosis and intervention of neurological dysfunction postoperatively.⁽¹⁴⁾ Of note in our data is the high post-operative admission rate at 23.3%. This mainly reflects the fact that we reserve the block to the more complicated types of access or complications of access like graft infections or anastomotic disruptions. As shown in the results most of the admissions are procedure related rather than block related. It is evident that the successful creation and maturation of AVFs is affected by a number of factors. Although preoperative planning and variations in the surgical procedure might affect the success of the procedure, additional factors in the perioperative period, including choice of anesthetic technique, may affect the physiologic response in the patient and the fistula. Use of regional blocks may likely improve the success of vascular access procedures. They have been shown to allow for significant vasodilatation, higher fistula blood flow, and sympathectomy-like effects.⁽¹⁵⁾ After administration of a regional block and the resulting vasodilatation, surgical plans have been reported to be altered (i.e., graft to fistula or proximal to more distal site) in up to 30% of cases. However, without a large-scale, prospective, clinical trial, it still remains unclear whether the prevailing anesthetic techniques are associated with different surgical outcomes.^(3,15) In our study this happened in 18 (6.3%) patients where planned prosthetic access was changed to native access. We have recently moved into ultrasound guided block which we hope will further improve our outcomes. A recent meta-

analysis have shown Ultrasound-guided peripheral nerve block to be associated with an increased overall success rate when compared with nerve stimulation or other methods.⁽¹⁶⁾

Conclusion

The use of brachial plexus block anesthesia for vascular access procedures for dialysis has greatly impacted our practice in vascular access surgery. It enabled us to perform these procedures without the inherent risks of general anesthesia and at an acceptable complication rate. It also opened opportunities for patients deemed previously unfit for general anesthesia to have complex hemodialysis access procedures. Hospital admission and bed occupancy for vascular access following general anesthesia is noticeably lower since the implementation of the brachial plexus block protocol. Our data further confirms the previously held belief that this is a safe and effective method of anesthesia for this high risk group of patients.

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