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Early Post-Operative Outcome and Complication of Arteriovenous Fistula Creation under Regional Anesthesia

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ABSTRACT

Introduction

Arteriovenous fistula (AVF) is the commonest vascular access for patients with end stage renal disease (ESRD) undergoing hemodialysis, however there is no consensus regarding mode of anaesthesia for creation of AVF. Mode of anaesthesia may have effect on outcome and complication of AVF.

Methods

This is a retrospective descriptive study conducted on the basis of data collected from patients undergoing AVF under brachial plexus block (BPB) from January 2018 to December 2018 at Manmohan Cardiothoracic Vascular and Transplant Center (MCVTC). Data regarding demographics, results and complications have been analyzed.

Results

A total of 79 patients (male: female=45:34) underwent AVF under BPB during one year period at University teaching hospital with a mean age group of 56.76±11.65 years (24-86 years). In three patients, the brachial plexus block failed and was substituted with general anaesthesia while 21 patients needed some adjuncts with block to create fistula. In 38 patients (48.10%) brachiocephalic fistula was created and in 48 patients (60.76%), plan to make fistula at proximal site was changed after application of block to more distal level. All fistulas were patent at 24 hours (100%, 79 patients) and the rate was 93.67% (74 patients) at 6weeks. The complications seen post procedure were limb oedema in five patients (6.33%), thrombosis and infection in one patient each, hematoma in two patients and bleeding in three patients.

Conclusion

Brachial plexus block is effective modality of anaesthesia to create AVF for hemodialysis as it increases chances of creating distal fistula and also increases the effectiveness of it.

Keywords: *Arteriovenous fistula, brachial plexus block, hemodialysis*

INTRODUCTION

The number of patients suffering from end stage renal disease (ESRD) is increasing worldwide and its only treatment is either hemodialysis or peritoneal dialysis till renal transplantation is done.[1] Hemodialysis is the commonest form of renal replacement therapy which requires good arteriovenous access for good and effective dialysis. Unfortunately, approximately one third of Arteriovenous fistula (AVF) fail at an early stage, which is influenced by various factors like patient, surgeon and unavoidable circumstances.[2,3] Some anesthetic techniques have claimed to influence the venous diameter as well as blood flow but there is no conclusive evidence yet to claim that these techniques can significantly affect long term

surgical outcome.[4-7]

Among different accepted modalities of anaesthesia, brachial plexus block (BPB) is given by injecting local anesthetic agents in and around brachial plexus to block motor and sensory nerves supplying the operative site, hence avoiding the need for general anesthesia. This requires practice and experience but nowadays due to availability of imaging techniques like ultrasonogram and nerve stimulator, the efficacy of the operators have improved and so has the success rate of block. Though general anesthesia causes vasodilatation, ESRD patients are at high risk of peri- and postoperative complications which can be avoided by regional anesthesia.[8,9] Above all, regional anesthesia can provide sympathetic blockade which also results in increase in venous dilatation and blood flow post operatively for several hours.[10,11] This can help prevent early thrombosis and fistula failure which ultimately leads to increase in the rate of primary patency (patency of the fistula from creation till intervention of any sort) and fistula maturation.[12] Local anesthesia may sometimes obscure operative site and may lead to inadvertent injury to vein or artery leading to spasm and low flow.[13] Thus, BPB not only lowers early AVF failure rates but also improves surgical ability to identify optimal graft site.

This study aims to determine whether BPB is effective in patients undergoing AVF creation and whether it has influenced our ability to identify the optimal site for arteriovenous access. We hypothesized that the regional anesthetic technique of ultrasound and nerve stimulator guided BPB would, as a result of improved intra- and post-operative vasodilatation and blood flow, increase primary patency at 6 weeks, thus increasing our efficacy and decreasing financial, social and mental burden of the patients.

METHODS

This is a retrospective descriptive review of 79 patients undergoing primary upper arm AVF creation under BPB at a tertiary university hospital for a period of one year (January 2018-December 2018). Careful clinical examination of the arteries and superficial veins of the upper extremity was performed on all patients undergoing AVF creation and those in whom veins were not identified clinically were subjected for ultrasound guided venous mapping. Among those who were screened, patients having brachial or cephalic vein ≥1.5mm to≤2.5mm without tourniquet and no stenosis or thrombosis of the veins distally were included for AVF under BPB. Minimum radial and brachial artery diameters were also measured in these patients and those with ≥1.5mm to ≤2.0mm diameter with triphasic arterial flow were included.

In all patients, order of vascular access was first radiocephalic followed by brachiocephalic and brachiobasilic fistula. Those patients not meeting above criteria were subjected either for arteriovenous graft or cuffed tunneled dialysis catheter. Retrospective data were collected from patients' history notes, operation notes and follow up data from dialysis records. Data regarding age group, comorbidities like hypertension, diabetes, smoking, heart disease and presence of vasculitis were recorded. Similarly, success of the block and need to use additional adjuncts were also noted. Type of fistula created, patency rates, failures and complications were taken into consideration to analyze the results of the block.

Brachial plexus blocks were performed by experienced anesthesiologists with minimum of two years experience of ultrasound guided nerve blocks using supraclavicular approach. The patient was placed in the supine position, with head turned to opposite side and ipsilateral arm adducted. After aseptic precautions, a high frequency linear ultrasound transducer (3-6 MHz, Sonosite Inc., USA) was kept in the supraclavicular fossa and the brachial plexus was identified. At a point 1.5 to 2.0 cm posterior to the lateral end of the probe, a skin wheal was raised with local anesthetic, 1% lidocaine. A 21G 4" nerve stimulating needle connected to a nerve stimulator was advanced through the same point towards the plexus under ultrasound guidance using in-plane approach. The current was adjusted until appropriate twitching of the hand was achieved at 0.4mA. After a negative aspiration test, 0.4 ml/kg of bupivacaine 0.25% was injected slowly, with repeated aspiration every 5 ml. The needle was maneuvered under ultrasound guidance among the divisions of the brachial plexus and given all around it to achieve a perfect block. Assessment of the block and hemodynamic variables were recorded.

After 15-20 minutes, adequacy of the block was checked and surgical procedure was started after reassessing the vessels and identifying the optimal AVF access site. Perfect block is defined as absence of autonomic, sensory and motor functions in desired limb assessed by vasodilatation and absence of sensation to cold swabs, absence of pain sensation and inability to move the limb respectively. Local infiltration of 1% lignocaine was given as adjunct in cases where patients experienced mild pain during the procedure, and was not considered as failure of block. The patients were sedated on request or as an adjunct with intravenous bolus doses of 0.5 mg of midazolam

Table 1. Age group distribution of the patients

Age group (years)	Number (%)
<20	0 (0)
21-40	10 (12.66)
41- 60	38 (48.10)
61-80	29 (36.71)
>81	2 (2.53)
Total	79 (100)

Table 2. Co-morbidities of patients

Comorbidities	Number (%)
Hypertension	68 (86.08)
Diabetes Mellitus	47 (59.49)
Smoker	18 (22.78)
Vasculitis	7 (8.86)
Heart disease	30 (37.97)

and 50 mcg fentanyl. In cases of unsuccessful block, patients were given general anesthesia after induction with propofol 1.5-2 mg/kg and 50 mcg fentanyl. Anesthesia was maintained with sevoflurane 1-2% with 100% oxygen and bolus doses of 50 mcg of fentanyl as required.

All the AVF patients received a preoperative prophylactic single dose of antibiotic (ceftriaxone and sulbactum 1.5 gm) intravenously and were operated by same vascular surgeons' team who has done more than 100 AVF before. After the block, optimal site was reassessed with the help of vascular Doppler and it was noted that the veins were visualized more distally than previously planned, which was before the performance of the BPB. In cases where good caliber of the cephalic vein was identified after the block, artery and vein were isolated and taken in control. Intraoperative visual assessment of the vein and artery was also done and end to side anastomosis was performed using 6.0 or 7.0 polypropylene suture. While in those with no cephalic vein, basilic vein was isolated and mobilized till the axilla. It was then endoscopically tunneled laterally and anastomosed with brachial artery using 6.0 or 7.0 polypropylene suture after confirming absence of kinking or twisting of the vein.

All the patients received 15-20 ml of heparinized saline (5000 units diluted in 100 ml of normal saline, 50 U/ml) to prevent thrombosis and to check the distal patency. In case of basilic vein, it was done to rule out twisting of the vein during tunneling.

Postoperative evaluation of the fistula was done by palpation and auscultation jointly by vascular surgeon and nephrologist at one week, two weeks and six weeks. Dialysis was started via internal jugular catheter inserted from contralateral side of AVF until cannulation of fistula became possible. The first cannulation was performed when veins became adequately matured usually after six to eight weeks. All of the patients were followed up for eight weeks unless they were unable to.

RESULTS

During the study period, 79 patients had AVF constructed in elbow under BPB. One patient died of myocardial infarction one week postoperatively. There were 45 males (56.96%) and average age was 56.76±11.65 years, age ranging from 24 to 86 years (Table 1).

The patients were also evaluated with respect to the presence of co-morbidities which has been shown below (Table 2).

Preoperative ultrasound was done in all patients to screen the patients suitable for BPB. Successful block was considered in 76 patients while three patients had to be converted to general anaesthesia (Table 3).

In 48 patients (60.76%) after BPB, due to venodilatation, the optimal site planned for fistula creation was changed distally. In 48.10% (38 patients), brachiocephalic fistula was made while in 25 patients (31.65%), brachiobasilic fistula with transposition was done and in 16 patients (20.25%) radiocephalic fistula was made.

In all patients undergoing AVF under BPB, good thrill was observed in immediate postoperative period. In one patient, the fistula got blocked at one week post-operatively because of bleeding and hematoma while four patients died due to myocardial infarction, bleeding, hematoma and

Table 3. Success rate of BPB

Success of brachial plexus block	Additional procedure	Number (%)
Successful	-	55 (69.62)
Successful with adjuncts	Sedation and analgesics, local infiltration	21 (26.58)
Unsuccessful	General anesthesia	3 (3.80)

Table 4. Complications after AVF under BPB

Complications	Number (%)
Thrombosis	1 (1.27)
Infection	1 (1.27)
Hematoma	2 (2.53)
Bleeding	3 (3.79)
Limb oedema	5 (6.33)

infection within two weeks. At six weeks follow up, 93.67% (74 patients) had good patent fistula ready to commence dialysis. Thus early failure rate was 6.33%.

The most common complication noted in this group was limb oedema, which was seen in five patients (6.33%) (Table 4). There were no instances of systemic toxicity, nerve injury due to block, hemo/pneumothorax from the block. There were also no instances of steal syndrome reported after AVF. No complications were found even in those patients where general anesthesia was given.

DISCUSSION

Arteriovenous fistula is an essential part of hemodialysis and its success accounts for the success of hemodialysis. Brachial plexus block not only gives good anesthetic effect for surgery in upper arm, but also helps in vasodilatation with subsequent increase in blood flow in the fistula in the immediate post-operative period.[4-7,11,12] In addition, it is safer in patients with end stage renal disease compared to general anaesthesia due to the prevalence of heart disease, diabetes and hypertension in this cohort of patients.[14]

The inclusion criteria in this study was almost similar to studies by Aitken E et al[4], Meena S et al[5] and Sahin L et al[7] who included all patients having cephalic and/or basilic vein diameter ≥ 1.5mm to ≤2.5mm without tourniquet and no stenosis or thrombosis distally and radial or brachial artery diameter ≥ 1.5mm to ≤2.0mm. The cohort of hypertensive, diabetic, smoker and heart disease patients are also similar to those studies.[4-7]

In this study, 12 patients had previously undergone some type of fistula creation and had a failure of those fistulas before entering into the study. In order to reduce the incidence of AVF failure, all patients had preoperative ultrasound guided venous mapping including those who had previous failed AVF as in other studies.[15,16,17]

The success of block was 96.2% and it was due to use of nerve stimulator and ultrasound guided application of block. In our study, the plan of AVF changed in 60.76% of cases, which means that after the block, veins dilated and reduction in peripheral resistance led to change of plan from brachiobasilic to easier and less complex procedure like brachiocephalic or radiocephalic fistula. This is also reflected in our success rates (93.67% at six weeks). This is similar to study done by Aitken et al[4] which showed that primary patency at three months was higher in BPB group than in local anesthesia group (OR 3.3) and was greater in radiocephalic fistula (OR 3.6). Similarly meta-analysis by Cerneviciute R et al also demonstrates that patients receiving regional anesthesia (12/143 patients with failure) have significantly better AVF patency rates compared to local anesthesia (36/143 patients with failure) (OR 0.28).[18]

The length of follow up was less in our study which might have impacted on resultant fistula failure rates observed. Although it is assumed that radio- and brachiocephalic fistula requires 6-8 weeks to mature, they may take longer time. Fistula thrombosis and stenosis might not be observed until three months postoperatively.[4,6]

Patients with ESRD are at increased risk of developing several serious complications hence most patients are subjected to regional anaesthesia which is also not without risk. There were countable complications like infection, hematoma, bleeding and limb oedema but none of the complications was attributed to regional anaesthesia. There was no reported hazard of regional anaesthesia like seizures due to local anaesthetic systemic toxicity, nerve injury, hemo-/pneumothorax and acute ischaemia of hand owing to the use of ultrasound and nerve stimulator. Solomonson et al also did not report any complication of regional anaesthesia and claimed it to be more effective than general and local anesthesia for creation of AVF.[14]

CONCLUSION

In our cohort of population, brachial plexus block can be an effective modality of anaesthesia for creation of AVF to decrease chances of failure and increase patency rates. This helps to obviate the need of general anaesthesia in these sick patients with end stage renal disease which not only decreases the morbidity and mortality but also decrease economic burden in these patients. Further well executed randomized control trials with long term follow up comparing different modalities of anesthesia and its outcome in AVF patency and failure, also reporting on complication of anesthetic technique, are required to accept it as gold standard procedure for primary AVF.

CONFLICT OF INTEREST

None declared.

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