Original Article

ARTERIO-VENOUS (AV) FISTULA: SURGICAL OUTCOME AND PRIMARY FAILURE RATE

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ABSTRACT

Objective:

Outcome and primary failure rate of arteriovenous (AV) fistula at our setup.

Data source:

Patients admitted or referred to the Department of Urology with end stage renal disease and GFR≤30ml/min.

Design of study: Prospective.

Setting:

Department of Urology and Renal Transplantation, Quaid-e-Azam Medical College/Bahawal Victoria Hospital, Bahawalpur.

Period: From January 2010 to December 2011.

Patients and methods:

Fifty patients of age 16 to 65 years with ESRD and GFR ≤ 30ml/min, were included in the study. Allens test was performed on every patient and left upper limb was used for AV fistula formation. Preoperative sonographic vascular mapping was obtained in over 90% of cases. Side-to-end AV fistula was made under local anesthesia. Every patient was discharged on the 1st day after surgery. The follow up was performed on outpatient basis, every 7th day for 8 weeks, after which fistula was released to puncture for hemodialysis.

Results:

All patients had end stage renal disease with GFR ≤30 ml/min. Majority of the patients (58.0%) were between 16 to 35 years of age. Fifty five per cent were presented with etiology of diabetic or hypertensive nephropathy. Radiocephalic fistula was made in 40 (80.0%) while brachiocephalic fistula was made in 10 (20.0%) patients. The post-operative complications observed were hematoma 2.0%, thrombosis 4.0%, steal syndrome 4.0% and primary failure rate (within 2 weeks) was 6.0%. Overall complication rate was 16.0% with procedural success rate was 84.0%

Conclusion:

AV Fistula is the gold standard for vascular access for hemodialysis with an overall success rate of about 84.0%, and primary failure rate of 08%.

Keywords: Vascular access, arteriovenous fistula, primary failure rate, side-to-end anastomosis

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INTRODUCTION

The establishment of vascular access for hemodialysis (HD) remains a challenge for vascular surgery. Improvement of chronic renal failure treatment and consequently

increased survival, the maintenance of vascular access and long-term treatment of its complications, has become an important cause of hospitalization, morbidity and patient costs.[1,2] The access of choice for HD is a primary arteriovenous (AV) fistula commonly in the upper limb, between the radial artery and the cephalic vein.[3-5]

An arteriovenous fistula (AV Fistula) is the connection of a vein and an artery, usually in the forearm, to allow access to the vascular system for hemodialysis, a procedure that performs the functions of the kidneys in people whose kidneys have failed.[4,5] The surgical creation of AV Fistula provides a long lasting site through which blood can be removed and returned during hemodialysis.[4] The preferred type of AV Fistula was a forearm radiocephalic fistula, followed by an upper arm brachiocephalic fistula, followed by a brachiobasilic transposition fistula.[6]

An AV Fistula has proven to be the best kind of vascular access for people whose veins are large enough, not only because it lasts longer but it is also less likely than other types of access to form clots or become infected.[7] Besides all the advantages, prolonged use of these accesses may lead to complications such as infection, anastomotic pseudoaneurysm, thrombosis, hematoma, steal syndrome/ischemia and their own obstruction.[8] In this situation, generally creation of new AV Fistula is indicated.

Present study was conducted to evaluate the outcome and primary failure rate of arteriovenous (AV) Fistula, at the Department of Urology and Renal Transplantation, Bahawal Victoria Hospital, Bahawalpur.

MATERIALS AND METHODS

This prospective study was conducted at the Department of Urology & Renal Transplantation, Bahawal Victoria Hospital/Quaid-e-Azam Medical College, Bahawalpur from January 2010 to December 2011. Patients of age 16 to 65 years with Stage 4 CKD and GFR below 30ml/min were included in this study. Total number of 50 patients who fulfilled the inclusion criteria were selected.

Detailed physical examination of every patient was done. Arterial pulses i.e. axillary, brachial radial, ulnar and blood pressure in both upper limbs was recorded. Allens test was performed on every patient and left upper limb was used for AV Fistula formation. Preoperative sonographic vascular mapping was obtained in over 90% of cases, and was used by the surgeons to select the optimal vascular access for each patient. Briefly, the minimum vessel diameter required was 2.5 mm for the vein (with a tourniquet) and 2 mm for the artery. Moreover, the draining vein had to be free of stenosis or thrombosis up to the medial subclavian vein, and without indirect evidence for central venous abnormality.

Procedural detail:

In diabetic patients and other patients at high risk of bacterial infection, a single dose of an antibiotic, preferably an aminoglycoside with dose adjustment for renal failure was given. Procedure was performed using a local anesthesia i.e. 2% lignocaine injected at the site of the proposed fistula. A pre-sterilized arterial tourniquet cuff was applied to the upper arm. After cleansing and sterilizing the site, a longitudinal incision was given. Vein was gently mobilized to the length needed to comfortably reach the arterial anastomotic site. The upper aspect of the vein was marked during dissection while the vein was in its normal position, in order to prevent rotation. Inflation of the tourniquet cuff to 60 mm Hg facilitated identification and dissection of the vein when necessary. Only the anterior surface of the artery was exposed. No arterial branches were ligated. At this point, 0.8–1.0 mg/kg of unfractionated heparin was given intravenously. A 10-mm arteriotomy was performed in the forearm while 5 mm in the arm with an ophthalmic knife and micro scissors. The vein was sharply cut and an end-to-side anastomosis was performed with Prolene 7/0 suture. In the forearm anastomosis was made between radial artery and cephalic vein while brachial artery and cephalic vein in the arm. The tourniquet cuff was deflated, hemostasis was assessed and the wound was closed in two layers using 4/0 absorbable sutures for the subcutaneous layer and 2/0 silk mattress sutures for skin. Gentle Antiseptic dressing was done.

Post-operative follow ups:

Every patient was discharged on the 1st day after surgery on oral antibiotics and anti-platelets for seven days with instructions to

begin hand exercises with a solid foam-rubber ball the size of a tennis ball on the 3rd post-operative day. The follow up was performed on outpatient basis, every 7th day for 8 weeks after which fistula was released to puncture for hemodialysis. Skin stitches were removed on the 10th to the 14th post-operative day.

The primary failure rate was assessed in the initial 2 weeks post-operatively by feeling strong thrill at arterial anastomosis and auscultation for continuous low-pitched bruit. Postoperative ultrasonography and duplex sonography (6 weeks after fistula creation) was obtained in some patients to assess the vein diameter, access blood flow, and depth of the fistula from the skin. All patients were evaluated for the presence or absence of complications i.e. infection, hematoma, thrombosis, aneurysms and steal syndrome, on follow up visits.

RESULTS

Total number of patients was 50. Age ranged 16 to 65 years with mean age of 40±15.4 years (Table 1). Majority of the patients (58.0%) were between 16 to 35 years of age. Out of these 50 patients, 43 (86.0%) were male and 07 (14.0%) were females with ratio of 6:1. Majority of patients presented with diabetic or hypertensive nephropathy i.e. 55.0% and 2nd most common cause was bilateral chronic obstructive uropathy i.e. 25.0%. Radiocephalic fistula was made in 40 (80.0%), while brachiocephalic fistula was made in 10 (20.0%) patients (Table 2).

The most common complication was primary failure rate i.e. within two weeks after the surgery which was 6.0% and was managed by making the new AV Fistula. Thrombosis and Steal Syndrome was seen in 02 (4.0%) patients each. For steal syndrome, fistula was closed and central catheter was used for hemodialysis. Overall complication rate was 08/50 (16.0%) with 05/43 (11.6%) male and 03/07 (42.85%) female patients (Table 3).

DISCUSSION

Many advances in the treatment of kidney failure have been seen since the first attempts at dialysis treatments were made in the 1920s. At one time dialysis was only thought of as a way to keep people alive until kidney

Table 1. Age distribution according to gender

Age (years)	Male		Female		Total	
	No. of patients	%age	No. of patients	%age	No. of patients	%age
16-35	25	50.0	04	8.0	29	58.0
36-50	10	20.0	02	4.0	12	24.0
Above 50	08	16.0	01	2.0	09	18.0
Total	43	86.0	07	14.0	50	100

Table 2. Percentage of patients according to site of AV fistula and gender

Site	Male		Female		Total	
	No. of patients	%age	No. of patients	%age	No. of patients	%age
Radiocephalic	35	70.0	05	10.0	40	80.0
Brachiocephalic	08	16.0	02	4.0	10	20.0
Total	43	86.0	07	14.0	50	100

Table 3. Post-operative Complications

Complications	Male		Female		Total	
	No. of patients	%age	No. of patients	%age	No. of patients	%age
Infection	00	0.0	00	0.0	00	0.0
Hematoma	01	2.0	00	00	01	2.0
Thrombosis	01	2.0	01	2.0	02	4.0
Steal Syndrome	01	2.0	01	2.0	02	4.0
Aneurysm	00	0.0	00	0.0	00	0.0
Primary failure	02	4.0	01	2.0	03	6.0
Total	05	10.0	03	6.0	08	16.0

function could be restored.[1] Often the treatment for kidney failure had to be discontinued within several days because patients' veins could not endure the trauma of frequent withdrawing and replacing blood.[7] An access or entry to the vascular system is needed to perform the blood-cleansing role of the kidneys through hemodialysis.[7] The first breakthrough came in 1960 with the introduction of an implantable Teflon tube, called a shunt, that was the first effective vascular access device.[9] Then the ground-breaking article by Brescia and Cimino in 1966[10] revolutionized the creation of the vascular access, and the Cimino fistula was soon used in almost all dialysis patients.

There are three types of vascular access; arteriovenous fistula, grafts and catheters.[11] An AV Fistula has proven to be the most successful type of vascular access in use today because it lasts longer but it is also less likely than other types of access to form clots or become infected.[12] The preference for its use is due to the longer period of working of these AV communications, low rate of complications and easy handling.[13-15]

There is no consensus on the optimal timing of fistula surgery. The DOQUI guidelines recommend to establish vascular access when the serum creatinine concentration exceeds 4 mg/dl and the estimated GFR is ≤ 25 ml/min.[16] In our study, we have selected patients with GFR ≤ 30ml/min. Fistulas are usually created in the nondominant arm and may be situated on the hand (the 'snuffbox' fistula'), the forearm (usually a radiocephalic fistula, or so-called Brescia-Cimino fistula, in which the radial artery is anastomosed to the cephalic vein), or the elbow (usually a brachiocephalic fistula, where the brachial artery is anastomosed to the cephalic vein).[10] A fistula takes a number of weeks to mature, on average perhaps 4–6 weeks.[17] In this study, we have used left upper limb and side-to-end anastomosis technique for AV Fistula creation in all patients and made 80.0% radiocephalic and 20.0% brachiocephalic fistulas.

The age at presentation in our study varied from 16 years to 65 years with mean age of 40±15.4 years. Most of the patients presented between 16-35 years. The results in our study confirm that patient age is not a factor in the success of procedure and AV Fistula should not be withheld from patients on the basis of age as observed by Lok CE *et al.*[18]

The main etiology of ESRD observed in our study was diabetic or hypertensive nephropathy i.e. 55.0% as also observed by Shemesh D *et al.*[19] In our study, 43 (86.0%) were male and 07 (14.0%) were female patients with ratio of 6:1. Out of these 43 male patients, 05 (11.6%) developed complications while 03/07 (42.85%) female patients developed complications. These results showed that fistulas are less likely to be useable for dialysis in women than in men which correlates with the results of Miller CD *et al.*[6] Numerous studies have reported a lower prevalence of fistula use in women than in men,[9,20] but the reasons for this discrepancy have not been adequately elucidated. One possible explanation is that vessels are of smaller caliber in women than in men, and therefore less likely to dilate sufficiently to sustain a blood flow adequate for hemodialysis. This hypothesis is supported by our recent finding that women were significantly less likely to have suitable vessels for construction of a fistula, when objective preoperative sonographic criteria were used.[21]

Nonnast-Daniel B *et al.*[22] started to use ultrasonography and Duplex sonography as valuable tools for assessing an established fistula. It has recently been recognized, however, that this technique is also valuable for preoperative assessment that will provide useful information to the surgeon. The primary aim is the indication to the surgeon whether an anastomosis at the usual site above the wrist will be successful and whether a steal phenomenon is a likely outcome. So, in our study, postoperative ultrasonography and duplex sonography (6 weeks after fistula creation) was obtained in some patients to assess the vein diameter, access blood flow, and depth of the fistula from the skin.

Haimov M *et al.*[23] and Suwitchakul C *et al.*[24] reported wound infection in 4.4% and 2.0% while in our study, it was not found in any patient. Incidence of primary failure rate (within 2 weeks) in our study was 6.0% while Rooijens PPGM *et al.*[25] reported its incidence 15.3% and Shemesh D *et al.*[19] 6.8%. Early failure was reported to be 40%-55% in the American series and about 7% to 10% in the European series.[9] So, primary failure rate was much lower in our study as compared to other

ones. Thrombosis observed in different studies range from 2.0-7.0%[18,23,24] while in our study it was found in 4.0% patients. Haimov M *et al.*[23] and Suwitchakul C *et al.*[24] observed steal syndrome in 1.6% and 2.0% respectively while in our study this rate was 4.0%. Incidence of hematoma in our study was 2.0% while Suwitchakul C *et al.*[24] reported its incidence 3.0%. False aneurysm was not seen in any patient in our study while in other studies it was observed in 2.0% cases.[18,19]

So, in our study, overall success rate was 84.0% which is a little higher but very much comparable to many previous studies.[5,7,13,19,23,24,25]

CONCLUSION

AV Fistula is the gold standard for vascular access for hemodialysis with an overall success rate of about 84.0% and failure rate of 06%. It is designed to improve the effectiveness of dialysis with fewer risks and complications than other vascular accesses. Moreover, this study also concludes that age should not be a limiting factor when determining candidacy for AV fistula creation and fistulas are less likely to be useable for dialysis in women than men.

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