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Outcomes of Hemodialysis Native Arteriovenous Fistula Creation in Iraq: A Combine Prospective and Retrospective Study

Lazim QJ[1]* and Benyan AKZ[2]

[1]Department of Cardiovascular Surgery, Al-Sadder Teaching Hospital, Misan Health Directorate, Iraq
[2]Department ofCardiothoracic Surgery, College of Medicine, University of Basrah, Iraq

Abstract

Vascular access (VA) is a lifeline for end stage renal disease (ESRD). The native arteriovenous fistula (AVF) is the oldest and the best. The study aimed to assess the outcomes of hemodialysis native AVFs creation in Iraq. Fifty-six patients (33 males, and 23 females) with ESRD, and native AVF were studied over five months, from December 2014 till April 2015.Demographic and clinical features as well as co-morbidities were checked. Allen'stest used to assess palmer arch patency, and examination of upper limb superficial veins were performed. Brachiocephalic or radio cephalic AVFs were created mostly under local anesthesia.Complications were noted during a follow up period of 3 weeks to 5 months. The mean age was 49 year. AVFs (n=58) were mostly brachiocephalic (n=46,79%). Side-side anastomosis was used in 42(72.3%) of participants. Most of fistulae functioned primarily. The significant complications were thrombosis (n=9, 16%), distal edema (n=6, 10.3%) and aneurysm (n=3,5%). Eight surgical revisions were required, which were three seroma evacuations, three thrombectomies and two aneurysmectomy with vessel ligations. AVF initial success was good, but the late complications were high.

Keywords: ESRD; Vascular access; Native AVF; Misan; Iraq

Correspondence to: Qusay Jummaa Lazim, Department of Cardiovascular Surgery, Al-Sadder Teaching Hospital, Misan Health Directorate, Ministry of Health/Environment, Misan,Iraq, E-mail: Medicalresearch22@yahoo.com

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Introduction

End stage renal disease (ESRD) is defined asan irrevesible decline in kidney function,when renal replacement therapy (RRT) is needed for survival [1]. Three modalities are present for treatment of ESRD: haemodialysis, peritoneal dialysis and renal trasplantation [2]. It is crucial to have a basic understanding of the dialysis vascular access (VA). A patient survival depends on proper functioning of this lifeline [3]. The vascular surgeon is frequently asked to provide a VA to ESRD patient for long term haemodialysis. The exposure of venous system of forearm to systemic arterial pressure results in the arterialization of veins. Being subcutaneously located; these veins can be punctured repeatedly at the time of H.D [4]. With modern dialysis techniques, the ESRD patient has many years of dialysis life ahead of him during which a successful renal transplant may represent only a dialysis free interval in his chronic renal failure history and hence the importance of suitable planning of VA surgery can be appreciated [5]. It is absolutely necessary to preserve the patency of upper limb veins [4,5]. VA surgery must be planned and conducted by a surgeon with an appropriate training and experience in this sphere [3-5].

There are four types of anastomosis can be constructed: side to side, end of vein to side of artery, end to end, and end of artery to side of vein. The side-to-side anastomosis yields the highest flow through the fistula but may be associated with venous congestion of the hand. Over time, arterial pressure may render the valves of the distal vein incompetent, resulting in retrograde flow toward the hand and venous hypertension. The end of artery-side of vein anastomosis also presents a risk of venous hypertension. This configuration reduces the risk of distal steal by preventing retrograde flow into the fistula, but at the price of lower flow through the fistula. Of the four options, the end of artery-end of vein variation produces the least distal arterial steal and venous hypertension but yields the lowest flow. The preferred configuration of the anastomosis is end of vein to side of artery. Dividing the vein reduces the risk of venous congestion in the hand; moreover, by allowing retrograde flow from the distal radial artery and the ulnar artery into the vein, which contributes approximately 30% of the total flow of the fistula, this approach yields maximal blood flow through the fistula. There is a risk of steal syndrome with such fistulas, but this problem is easily corrected by ligating the radial artery distal to the fistula, thereby converting the anastomosis to an end-to-end configuration [6-8].

The study conducted to find out the types, causes and rates of complications following a native AVF creation for ESRD patient in our practice, comparing our results with the national and international

studies and suggesting preventive measures according to standard international guidelines.

Methods

Fifty-sixpatients (33 males, 23 females) with ESRD and native AVF were included in this study. There were 2 groups of patients. Prospective group (n=25) referred to vascular surgical unit, Al-Sadder Teaching Hospital, Basra, Iraq over 5 monthsfrom December 2014 to April 2015 for creation ofnative AVF in the upper extremity for hemodialysis (H.D). Two male patients of prospective group underwent twice AVF creation due to nonfunctioning the first ones, therefore; total number of AVF was 58. The study was designed to be prospective in order to document as much as possible of the demographic and clinical characteristics of patients. And potential early complications avoiding the shortcomings of retrospective studies common in our practice.

On arrival to our unit, the patients were thoroughly assessed clinically noting the duration of the disease, co-morbidities like DM, hypertension and PAD. Drug history particularly anticoagulant and anti-platelets was checked. Previous H.D vascular access was checked also. The arteries in the UL were examined (Allen's test for patency of palmer arch) and the state of superficial veins looking for a good size vein especially the cephalic vein. The patients were warned not to have venipunctures or I.V cannulation while waiting for surgery. Edema of UL and prominent collateral veins on shoulder and chest wall were observed when present as signs of central venous stenosis. The standard policy was to place the AVF at non-dominant wrist (radio cephalic). Elderly patient as well as patient with co-morbidities such as DM, PAD and those with non-available superficial vein at wrist was offered AVF at cubital fossa. Operations were done under local anesthesia except one child (8 Year) old patient under G.A. Function of AVF was judged by feeling a local thrill and listening to a bruit. The patients were kept in the hospital up to 24 hours, after that discharged home if no complications happened. Further follow up was continued subsequently during sessions of H.D. The length of follow up ranged between three weeks to five months.

Retrospective group (n=31) of patient undergoing regular H.D. via a native AVF in the upper extremity in the H.D. unit and any patient with a native AVF admitted in the vascular surgical ward due to complications related to creation of AVF or its use. We reviewed the patient's old file to collect the wanted data. The same data sheet was used to record the relevant information beside a direct physical examination. To diagnose complications due to surgery or H.D. care.

Results

The total number of patients were 56 (males n=33, 58.9% and females n=23, 41.1%). The total no. of fistulae was 58 (two male patients underwent twice AVF creation due to failure of the first ones). The study involved a prospective group (n=25,44.6%) and a retrospective group (n=31, 55.4%). Patient ages range from 8 yr. to 76 yr., mean age is 49 year. The total no. of native AVF was categorized into 3 groups according to anastomosis technique:

- Group A: Side of artery to side of vein without ligation of distal part of vein (n=27, 46.5%).
- Group B: Side of artery to side of vein with ligation of distal part of vein (n=15, 25.8%).
- Group C: Side of artery to end of vein (n=16, 27.5%).

The table displays types, sites and sides of AVF (Table 1). 58

Table 1: Types, sites and sides of AVF.

Type	Brachio-cephalic		Radio-cephalic		Total, %
	Dominant	Non-dominant	Dominant	Non-dominant	
Group A	9	18	0	0	27, 46%
Group B	4	11	0	0	15, 25%
Group C	1	3	3	9	16, 27%
Total	14	32	3	9	58

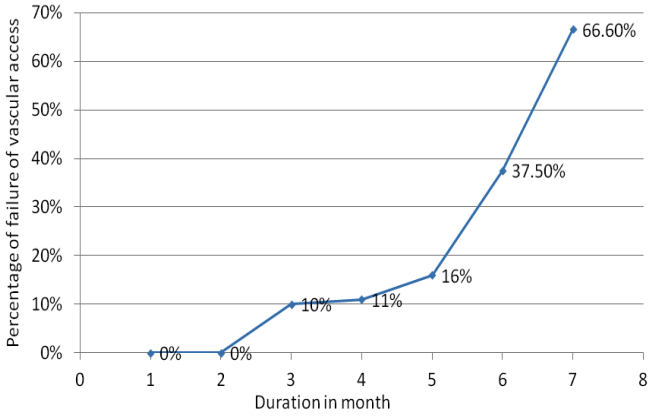

Figure 1: Correlation between the duration (from diagnosis of ESRD till creation of AVF) and percentage of VAF.

operations were done in 56 patients over a variable period. Most of these operations were in the form of brachio-cephalic AVF (n=46, 79%) whilst radio-cephalic AVF were (n=12, 21%). AVFs were more frequent in non-dominant (mostly left) side (n=41, 70%) and less frequent in dominant (mostly right) side (n=17, 30%). All radio-cephalic AVF were of group C type (side of artery to end of vein). Two of radio-cephalic AVF failed to mature, therefore; another two AVF were created in form of brachio-cephalic AVF in the same non-dominant (left) side, therefore; none of patient in this study had bilateral AVF.

The below figuredisplays the correlation between the duration (from diagnosis of ESRD till creation of AVF) and percentage of primary vascular access failure following AVF creation (Figure 1). This diagram shows that risk of failure increased with increase duration. Duration was ranged from 13 days 7 months. Failure of vascular access was (as will show below) either due to failure of maturation or thrombosis.

The below table displays causes and management of vascular access failure (VAF). Total no. of patient with VAF was 11 patients (19.6%) (Table 2).

The table displays comparison in patency rate between brachiocephalic and radiocephalic AVF. The total patency rate during this study was (84.5%) (Table 3).

The below table displays complications in both prospective and retrospective groups. The two most common complications were thrombosis (16%) and distal edema (10.3%) (Table 4).

The blow table displays complications according to anastomosis techniques of AVF creation were applied in this study (Table 5). The most significant result in this table is that all distal edema complications occurred in group A (side of artery to side of vein without ligation of distal part of vein) (Figure 2).

The table displays the relationship between the use of intraoperative

Table 2: Causes and management of VAF.

Causes	Number	Total number of patients with VAF, %	Management
Thrombosis	9, 16.1% Early (<3mo.), (no.6) Late (>3mo.), (no.3)	7, 12%	Three patients underwent thrombectomy during the first 24 hours, two of them successes. Six patients underwent permanent double lumen catheter insertion.
Failure of maturation	2, 3.5%	2, 3.5%	Creation of another AVF for both patients.

Table 3: Comparison in patency rate between brachiocephalic and radiocephalic AVF.

	Thrombosis	Failure of maturation	Total of failure	Patency rate	Comment
Brachiocephalic (n=46)	7, 15%	0	7, 15%	85%	Failure of one trial of thrombectomy
Radiocephalic (n=12)	2, 16%	2, 16%	2, 16%	84%	Both of thrombotic AVF respond to thrombectomy

Table 4: Complications of AVF creation.

Complications	Prospective group (27 AVF)	Retrospective groups (31 AVF)	Total, %
Thrombosis	6	3	9, 16%
Aneurysm	1	2	3, 5%
Seroma	2	1	3, 5%
Bleeding	2	0	2, 3.5%
Distal edema	2	4	6, 10.3%
Wound infection	2	0	2, 3.5%
Arterial steal syndrome	0	1	1, 1.7%
Hematoma	1	1	2, 3.5%
Total	16	12	28, 48.2%

Table 5: Complications according to anastomosis techniques.

Complications	Group A (no. 27)	Group B (no.15)	Group C (no. 16)
Thrombosis	5, 18.5%	2, 13.3%	2, 12.5%
Aneurysm	2, 7.4%	1, 6.6%	0
Seroma	1, 3.7%	1, 6.6%	1, 6.2%
Bleeding	1, 3.7%	0	1, 6.2%
Distal edema	6, 22%	0	0
Wound infection	1, 3.7%	0	1, 6.2%
Arterial steal syndrome	1, 3.7%	0	0
Hematoma	1, 3.7%	1, 6.6%	0
Total	18, 66.6%	5, 33.3%	5, 31.2%

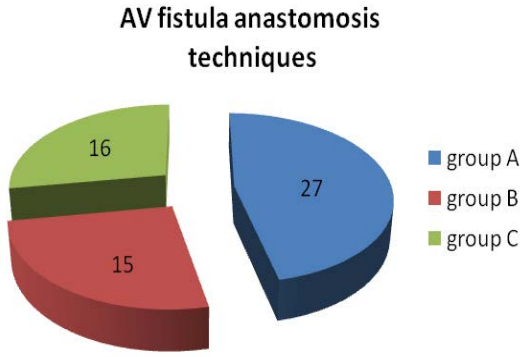

Figure 2: AVF anastomosis technique groups.

Table 6: Relationship between the use of intraoperative heparin and occurrence of complications (bleeding, hematoma and thrombosis)

	Bleeding	Early thrombosis (<3 mo.)	Late thrombosis (>3 mo.)	Hematoma
Group I	2, 5.5%	1, 2.7%	1, 2.7%	1, 2.7%
Group II	0	5, 22.7%	2, 9%	1, 4.5%
Total	2	6	3	2

heparin (at time of vascular clamp) and occurrence of complications (bleeding, hematoma and thrombosis). 58 AVF were categorized to two groups (Table 6):

- Group I: 36 AVF received heparin 62%.
- Group II: 22 AVF did not receive heparin 38%.

The risk of bleeding and haematoma was more in group I and the risk of thrombosis was more in group II:

- Bleeding was treated by a gentle pressure aand stopped spontenously when effect of heparin finished (1-2 hours).
- Haematoma was treated by evacuation under local anesthesia.
- Thrombosis was managed as mention above.

Discussion

Arteriovenous fistula as a form of permanent vascular access for regular haemodialysis was adopted at Al-Sadder Teaching hospital in Basra since 1975. The present study focused on two types of complications: the short term complications in prospective group and the long term complications in retrospective group.

ESRD affectpeople at different ages but people in the active period of live represent a special burden to their families as well as the society. Most of our patients were young adult (the peak age was in the fifth decade, 49 year); this is similar to United Arab Emirates in which the highiest incidence rate of ESRD was reported among the 45-55 years age group and to Kuwait in which the median of age among ESRD pt. was 45 year [1] . In contrast , in Saudi Arabia, incidence and prevalence of ESRD were linked directly to increasing age [1]. Hassanien et al. reviewed 44 articles describing the epidemology of ESRD in countries of the Gulf Co-operation Council and found that the proportion of males was slightly higher than females [1], as in our study (males 58.9%, females 41.1%). Constraction of H.D. AVF can be influnced by the age of the patient. In elderly patient, the procedure may be difficult because of atherosclerosed vessels. It is also difficult in paediatric patients as they have small vessels [4]. The youngest patient in this study was a girl 8 yr. old age.Six patients were in the eighth decade. It is moredifficult to construct a fistula in women than in men because their veins tend to be rather less well developed [4].

In this study we chose the native(natural) AVF becauseit was the most common type of vascular access creation in Al Sadder teaching hospital, Basra, this is similar to study in Medical city, Baghdad (91%) of VA procedures was in form of native AVF [9], and this coincides the National Kidney Foundation (NKF) recommendation which recommends that at least 65% of patients with permanent access for hemodialysis should have natural accesses [10].

The predominant brachiocephalic type (79%) in this series is most likely attributed to unavailability of veins at wrist region and the technical ease of creation of brachiocephalic AVF. The radiocephalic AVF gives a long segment of arterialized vein for needling and preserves proximal vessels. It was only feasible in (21%) of our patients which is comparable with other studies [11,12]. The radiocephalic AVF is the best choice and should have been used more frequently, though it is technically more demanding. The patency rate for the patients who received brachio-cephalic AVF was 85%, for radio-cephalic AVF was 84% and total patency rate was (84.5%) and in comparison, with other studies [9,13,14], there were nearly lower patency rate in this study.

Complications were seen in (48.2%) of patients in our study and most of these complications were successfully treated with no mortality rate and our result is high in comparison with other studies [15-17]. This high rate of complications may be due to high % of complications occurred in group A which was the most common (46.5%) anastomosis technique in our study. Regarding to anastomosis techniques, the patency rate was good and nearly equal in all types, but the postoperative complications were higher (66.6%) in group A, in comparison to other studies [16]. the postoperative complications rate was nearly equal in both group B (33.3%) and group C (31.2%). Thrombosis was the major cause of fistula failure even with proper surgical intervention as in comparison with other studies [13,14].

Thrombosis is the most frequent complication of AVF for H.D [18]. Surgeons and interventional radiologists have developed valuable tools to cope with access stenosis and occlusion [18]. Surgical and interventional methods are equally effective as far as clot removal is concerned. Historically, native fistula malfunction and thrombosis were treated by using surgical thrombectomy and revision, resulting in the eventual exhaustion of the veins and the need to create a new access. Initially applied in the 1980s, percutaneous techniques such as PTA (Percutaneous Transluminal Angioplasty), thrombolysis and mechanical thrombectomy allowed treatment of stenosis and fistula thrombosis without surgery [19]. In the present study, duplex ultra sound and fistulography were not used to evaluate the underlying causes and PTA was not used in treatment of this complication because of inadequate facilities.Three cases of AVF thrombosis in prospective group treated by surgical thrombectomy within the first 24 hours, two of them successes.

The other six cases of AVF thrombosis presented late with nonfunctioning AVF. Vascular access in those patients achieved by insertion of a permanent double lumen catheter due to absent suitable vein in upper limbs.

Use of intraoperative heparin is a standard routine followed by many authors [3,4] to minimize thrombosis of the small vessels prior to clamping. This was applied in 62% of patients as compared with other study [16], causing less thrombosis and more bleeding which was treated by a gentle pressure (packing and bandaging) and stopped spontaneously when effect of heparin finished (1-2 hr). The patients in this study were discharged home early (within 24 hr). This may be related to local circumstances of the hospital with limited beds as the trauma cases are huge in number and they are in urgent need for empty beds. We believe that a patient with recently created AVF for H.D. needs to be admitted a bit longer to allow for adequate patient monitoring and diagnosing potential complications such as bleeding and early thrombosis as well as to receive prophylactic antibiotics. Each patient in the prospective group was seen at least once with a mean of three follow up visits in five months period which indicate a good follow up.

The outcome of the surgery is affected by the time interval between the establishment of diagnosis of ESRD and the time of surgical creation of AVF. The failure rate is increasing with increasing time interval with peak increase after five months, it is comparable with other study [20]. With time the upper limb veins will be destroyed and the chance to find a suitable vein for creation of AVF will be low, therefore; we advise the nephrologist for early referral of ESRD patient to vascular surgeon.

Study limitations

- Limited number of patients was included in this study due to following causes:

a. Some patients who did H.D. in the H.D. center, their AVF were created outside Al-Sadder Teaching hospital (either in private hospital or outside Iraq), and there was a difficulty to access their required data.

b. Loss of some patients follows up either due to death or they attended private clinic.

- All patients were discharged home within the first 24 hr. postoperatively which is a short period to monitor for potential early complications such as bleeding, hematoma and early thrombosis.

- The clear majority of AVFs in this study (46 out of 58) (79%) were brachio-cephalic in type which is the second preferred choice after the radio-cephalic fistula.

- The most common (46.6%) type of anastomosis technique was (side-side) which is the second preferred choice after the (side of artery to end of vein) and it is associated with more complication.

Conclusion

Side-side brachio-cephalic AVF without ligation of distal part of vein has a good patency rate but with a high complication rate.End-sideradiocephalicAVF has a good patency rate and lower complication rate. Side-side AVF with ligation of distal part of vein has nearly equal patency and complication rates with end- side AVF. Early creation of AVF after diagnosis of ESRD (<5 month) has a lower rate of vascular access failure than late creation (>5 month). Use of intraoperative heparin just before vessels clamping associated with low risk of thrombosis.In this study,the patency rate is good, but the complication rate is high.

Recommendations

- Once a patient is diagnosed as an ESRD, he (she) should be referred to a vascular surgeon as early as possible to create an elective native AVF.

- Preservation of upper limb superficial veins by avoiding intravenous cannulation or vein puncture.

- Doppler examination of the veins is currently an essential investigation prior to creation of AVF to select an appropriate vein and to exclude central vein stenosis.

- The initial H.D. should start with native AVF rather central venous catheters that can result in central venous stenosis and eventual failure of future vascular access.

- End-side radiocephalic AVF is the preferred choice. The technical ease should not be the determinant factor in our choice of fistula; the long-term patency and minimal morbidity should be considered.

- Proper care, cannulation and handling of AVF by the dialysis unit staff are vital.
- Early recognition and referral of patient with AVF complications. Many of such complications can be managed by thrombectomy, drug therapy,endovascular interventions and surgery as a last resort.
- Multidisplinary approach to patients who need VA for H.D., follow up of those patients is a duty of both nephrologist and surgeon together with ancillary staffs.
- Meticulous surgical techniques should always be stressed.

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