International Surgery Journal
Atif H et al. Int Surg J. 2019 Apr;6(4):1029-1034
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20191060

Original Research Article

Modified technique of end to side distal radio-cephalic shunt to overcome juxta-anastomotic stenosis

Haitham Atif*, Nehad Abdou Zaid, Abd El-Mieniem Fareed Mohamed, Yehia Mohamed Alkhateep

Department of Surgery, Faculty of Medicine, Menoufia University, Egypt

Received: 20 February 2019
Accepted: 06 March 2019

***Correspondence:**
Dr. Haitham Atif,
E-mail: haithamatif19@gmail.com

ABSTRACT

Background: Juxta-anastomotic stenosis (JAS) is one of the predominant causes of arteriovenous fistula (AVF) failure, with the reported incidence of 65%, so that technical modification to alter the outflow vein configuration using the modified technique has been applied to prevent JAS and improve AVF maturation. The aim of the study to evaluate the modified technique of end-to-side distal radiocephalic A-V fistula regarding maturation, patency rate and the resultant juxta-anastomotic stenosis.
Methods: This prospective study was carried out on 80 patients with end stage renal disease (ESRD) at vascular surgery unit in general surgery department, Menoufia university hospital that prepared for dialysis. 40 patients "intervention group" underwent the modified technique to establish a functioning radiocephalic fistula; the other group (40 patients, control group) had the conventional technique of end to side radiocephalic fistula. Follow up of patients was over 6 months regarding function, patency rate and development of juxta-anastomotic stenosis.
Results: There was statistically significant difference between 2 groups regarding primary failure, patency and JAS. Primary failure was detected in 2 patients in group A and in 5 patients in group B (p-value is 0.04). Considering patency rate, after 3 months the ratio between group A and group B was 37:34 with significant P value of 0.02, and after 6 months the ratio was 35:33 with P value of 0.03. Regarding JAS, by the end of follow up period, 4 patients diagnosed with JAS in group A, while group B had 8 patients, with p value of 0.01.
Conclusions: Modified technique of end to side anastomosis for primary radio-cephalic fistula creation has better patency rate and low incidence of JAS than conventional method.

Keywords: Dialysis, JAS, Modified technique, Patency rate, Radiocephalic fistula

INTRODUCTION

The prevalence and incidence of ESRD continue to rise worldwide due to the increasing burden of conditions that cause kidney failure, such as diabetes and hypertension. Although increasing incidence of ESRD, recent data suggests some improvement in mortality rate outcomes.[1] Radiocephalic autogenous arteriovenous fistulas (RCAVFs) are the first choice for the vascular dialysis. This is a logical choice, as autogenous fistulas demonstrate higher patency, lower infection rates, fewer general complications than fistulas created with synthetic material; further fistulas can be created proximally if needed (brachio-cephalic/basilica fistula), and the risk of steal syndrome is reduced as well.[2] Even so, the primary and secondary failure rates of the conventional end to side RC-AVF may be high due to thrombosis and occlusion, failure to mature, and low fistula flow. Primary patency at 1 year is described to be around 58-63% in several studies, but varies widely.[3] Juxta-anastomotic stenosis (JAS) is one of the predominant causes of arteriovenous fistula (AVF) failure, with the

reported incidence of 65%, This lesion is always seen within 1 to 4 cm from the site of AVF anastomosis, resulting in luminal narrowing, decreased fistula flow leading to arrested maturation, and often early thrombosis.[4] Although factors including handling of the tissues, suture technique, physiological changes related to increasing blood flow, shear stress, and (patient and surgeon) related variables have been implicated, the exact etiology of JAS still remains unclear.[5] So, it was hypothesized that technical modification to alter the outflow vein configuration using the modified technique would prevent JAS and improve AVF maturation.[6]

METHODS

This is a prospective analysis of collected data from patients with ESRD who require regular dialysis. Before the beginning of the study, ethics approval was obtained from the Menoufia University Hospital's Review Board and a written informed consent was obtained from all participants prior to subject characterization and sample collections. Patients were randomly classified into 2 groups using closed envelope method. Patient group (40 patients) had radiocephalic fistula created with the modified technique and control group (40 patients) had their fistula performed with the conventional technique.

Preoperative work

History taking of chronic diseases including diabetes mellitus, peripheral vascular disease, and hypertension was obtained.

Patients underwent general examination to detect evidence of congestive heart failure, arterial examination through palpation of healthy vessels to find out compressibility, and pulse equality bilaterally. The Allen's test was used to confirm a patent palmar arch, bilateral extremity blood pressures were recorded and found to be equal. Venous system inspected with and without a venous pressure tourniquet in place. Doppler ultrasound examination was done for measurement of mean vein and arterial diameter along the vascular tree. Complete laboratory investigations including complete blood count, random blood sugar, serum creatinine, bleeding profile, and liver enzymes were done preoperative.

Inclusion criteria include patients with end stage renal disease prepared for dialysis with appropriate artery and vein diameters.

Exclusion criteria include patients with prior radiocephalic fistula surgery, cephalic vein diameter less than 2.5mm, arterial lumen diameter less than 2mm, proximal venous outflow obstruction, hypotensive patients, atherosclerotic radial artery and non-patent palmar arch.

Follow up

Patients were followed up regularly at 1st, 3rd and 6th month postoperative. Duplex us was considered for all patients after 6 months.

Primary failure (an AV fistula that is never usable or fails within the first three months of its use) and Juxta-anastomotic stenosis (lesion which is always seen within 1 to 4 cm from the site of AVF anastomosis, resulting in luminal narrowing, decreased fistula flow leading to arrested maturation) were considered during early follow up period.

Anastomotic technique

Group A (operated through the modified technique)

Cephalic vein, is dissected, marked for orientation, divided, the distal end is ligated using 2-0 silk, and the proximal cut end is over sewn with 6-0 prolene after the vein is gently distended with heparinized saline. The radial artery was dissected by scissors on the medial and lateral sides until a pedicle of artery was isolated for proximal and distal control. The artery was opened by using scalpel size 11. A 10-12mm longitudinal anterior arteriotomy was performed using Potts scissors. Both vessels were prepared for the anastomosis while preserving the pedicle around it. Then vein to artery anastomosis through posterior venotomy using scalpel size 11 and Potts scissors and cephalic vein is moved medially over the artery, So, the fistula is created between the posterior aspect of the vein (underside of the vein) and the anterior (upper) aspect of the artery with a 6.0 polypropylene (Figure 1).

Figure 1: Construction of anastomosis in group (A).

Statistical analysis

The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 21, SPSS Inc. USA). Data were described using mean and standard deviation (SD) and frequencies according to the type of the data (quantative or categorical respectively). Chi-

square and fisher exact test were used for comparison of qualitative variables. We used one way Anova test to compare between means of categorical and numerical data. Significance level (P-value) was adopted, i.e. p<0.05 for interpretation of results of tests of significance.

RESULTS

Group A consisted of 22 male patients with age mean of 58.50±11.6, 18 patients had diabetes, 28 patients had hypertension, mean preoperative distal vein size was 2.78±0.19 and mean preoperative distal arterial size was 2.2±0.14, while in group B, 25 patients were males with age mean 60.52±9.7, diabetes was detected in 13 patients and hypertension in 32 patients, mean preoperative distal vein size was 2.74±0.17 and mean preoperative distal arterial size was 2.2±0.14. The average maturation time of group A was 45 days, while in group B was about 48 days (insignificant p-value between two methods, 0.7) (Table 1).

Table 1: Patients' demography (n=80)

	Modified method N=40	Conventional method N=40	p-value
Sex			
Male	22 (55 %)	25 (62.5 %)	
Female	15 (45 %)	15 (37.5 %)	0.32
Age(years)			
Mean±SD	58.5±11.6	60.5±9.7	0.4
DM			
No	22 (55%)	27 (67.5%)	
Yes	18 (45%)	13 (32.5%)	0.17
HTN			
NO	12 (30%)	8 (20%)	
Yes	28 (70%)	32 (80%)	0.22
Preoperative distal vein size			
Mean±SD	2.7±0.19	2.74±0.17	0.2
Preoperative arterial size			
Mean±SD	2.2±0.14	2.2±0.14	1

Primary failure in patient group was detected in 2 patients (5%) 1 month postoperative, while in control group 5 patients (12.5%) had primary failure; two of them is 1 month postoperative and three were detected 1.5 month postoperative (p-value is 0.04). Duplex ultrasound was performed for all cases presented with primary failure and juxta-anastomotic stenosis was detected in the whole 7 cases and was attributed as the cause of primary shunt failure (Figure 2).

Patency assessment during follow up revealed that in "Intervention group" 37 patients (92.5%) had functioning shunts after 3 months and one thrombosed shunt was detected with duplex ultrasound. After 6 months, 35 patients (87.5%) had patent shunts as 2 additional shunts were found thrombosed using duplex ultrasound. While in "control group", 34 patients (85%) had patent shunt after 3 months with one thrombosed A-V fistula, and 33 patients (82.5%) had patent shunts after 6 months with one additional thrombosed shunt diagnosed using duplex ultrasound. So, there was statistically significant difference between two methods at 3 and 6 months (p-value is 0.02 and 0.03 respectively). This mean the modified technique had better patency at 3 and 6 months postoperative (Table 2).

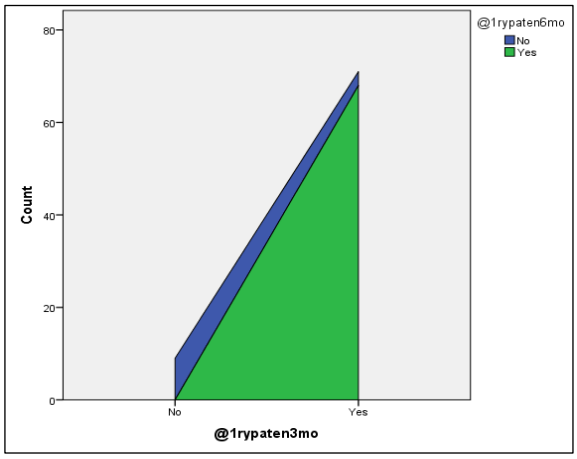

Figure 2: Primary patency rate at 3 and 6 months.

Table 2: Comparison between modified method and conventional method regarding primary failure and patency.

	Modified method	Conventional method	P-value
Primary failure	2 (5%)	5 (12.5%)	0.04
Patency 1 month	37 (92.5%)	34 (85%)	0.02
Patency 3 month	35 (87.5)	33 (32.5 %)	0.03

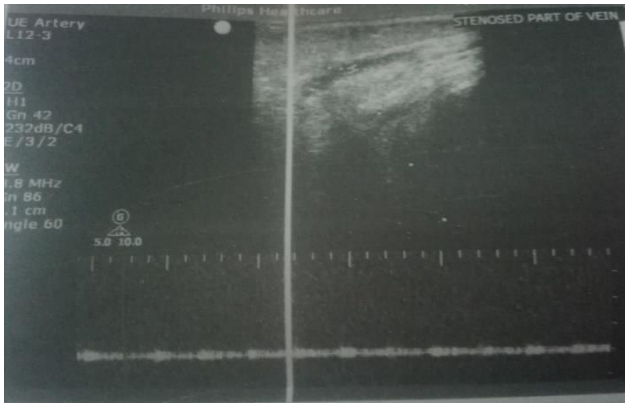

Figure 3: Duplex ultrasound revealing Juxta-anastomotic stenosis.

After 6 months, 2 cases in "Intervention group" had weak thrill and Juxta-anastomotic stenosis was detected on duplex ultrasound examination, while 3 cases were detected in "control group". By the end of follow up period, the number of patients with JAS in group A was 4

(10 %), while group B had 8 patients (20 %), with p value of 0.01. This means statistically significant difference in JAS development between 2 techniques (Figure 3).

Complication rate was found statistically indifferent between two methods regarding pseudoaneurysm. One patient (2.5 %) in group A and 2 patients (5%) in group B, with P value of 0.8.

Regarding infection, 2 patients (5%) had infection 1 week postoperative in group A with good response to antibiotics, while 3 patients (7.5%) had infection in group B ten days postoperative and resolved on antibiotics (p-value 0.1). So, no significant increase in incidence of infection between two groups.

Regarding hematoma 1 patient in group A developed hematoma and another one in group B as well (2.5%) with p value of 0.7. Both cases were managed successfully with conservative treatment.

Venous hypertension occurred in 2 patients in group A (5%), while in only 1 patient (2.5%) in group B, with insignificant P value of 0.8.

DISCUSSION

The improved mortality rate associated with hemodialysis has produced a critical need for a reliable vascular access. Based on the superior patency and lower morbidity associated with arteriovenous fistula (AVF), the recent practice guidelines of the American Society for Vascular Surgery as well the Kidney Disease Outcomes Quality Initiative propose creation of AVF before placement of prosthetic grafts or use of central venous catheters. With the inception of the "Fistula First" initiative, the current prevalence of AVF in the U.S. is 56% and is continuing to increase.[7]

Despite this, the early thrombosis and failure to mature continues to be a major problem with AVF creation. A recent multicenter controlled randomized trial conducted by the Dialysis Access Consortium (DAC) and sponsored by the National Institutes of Health (NIH) reported a 60% failure of maturation in AVF.[8]

In the present study, demographic criteria including age, sex, diabetes mellitus and hypertension was comparable in both groups. It was found that the 5 of patients (7 %) who suffered from failure of maturation were diabetic, with P value of 0.04.

The significant relationship between diabetes mellitus and primary failure of fistula was evaluated by Konner et al, who reported that primary wrist arteriovenous fistula in diabetics encountered major obstacles i.e. high rates of early thrombosis and reduced blood flow rates secondary to inadequate venous remodeling and dilatation. The problems were compounded by the increasing age of the diabetic population and the poor state of the peripheral veins as a result of repeated previous blood sampling and intravenous therapy during preceding hospitalizations.

However other studies assumed no significant relation between diabetes and primary failure e.g. Al- Benna et al, have studied a total number of 58 upper limb autogenous arteriovenous fistulas.[9] All patients had history of either type I or type II diabetes mellitus. Ten patients of his studied group had history of failed radiocephalic arteriovenous fistula, although this number of patients was small; he published that it is difficult to justify subjecting additional diabetic patients to radiocephalic arteriovenous fistula for maintenance hemodialysis when options for durable alternative autogenous fistulae exist.[10]

Most of primary failure in this study occurred in first month, this is consistent with that reported by Nawaz S et al, around 55 % of the fistula failures (24 of 43) occurred during the first month, as a result of failure of the vein to mature adequately or acute thrombosis.[11] Juxta-anastomotic stenosis (JAC) with a variable reported incidence of 43% to 65% is a major cause for early AVF failure and arrested maturation.[12]

Considering patency during follow up, there was statistically significant difference between two methods at 3 and 6 months (p-value are 0.02 and 0.03 respectively) which means the modified technique had better patency rate than conventional method.

Although RCF is considered the standard fistula for arteriovenous access, the primary patency rate has been disappointing. In a meta-analysis review, 37 using a Medline search performed in the English literature between the years 1970 and 2002, studies pertaining to RCF were examined using the standard mixed effects model, which allows for variability between different studies. Eight prospective and 30 retrospective studies were analyzed.

The estimated primary failure rate was 15.3% (95% confidence interval [CI] 12.7e18.3%). In addition, the pooled estimated primary and secondary patency rates were 62.5% (95% CI, 54.0e70.3%) and 66.0% (95% CI, 58.2e73.0%) at 12 months, respectively.

Compared with conventional technique study by Golledge et al, on 107 consecutive patients underwent formation of an RCF for permanent hemodialysis access. The median follow-up was 24 months, the primary patency rates were 69% at 12 months and 56% at 24 months. The authors of this study concluded that one-third of RCFs fail irreversibly within 2 years.[13]

By the end of follow up period, there was statistically significant difference in JAS development between 2 techniques. This is consistent with Nirvana Sadaghianloo et al, study that showed significant reduction in JAS and improvement in AVF maturation with the modified technique. Current evidence highlights the role of outflow

vein configuration in AVF maturation. Minimal alteration of vein wall configuration and avoidance torsion, technique improves AVF maturation.[14]

Regarding infection, there was no significant increase in incidence of infection between two groups. According to Padberg et al, 2008, the reported incidence of infections affecting the AV access site ranges from 0.56% to 5% per year for autogenous AV access, management may respond to antibiotics. If associated with bleeding and proximity to the anastomosis ligation may be required.[15]

Incidence of thrombosis showed insignificant difference between 2 study groups. This is in agreement with Schinstock et al, who had reported that thrombosis is a major cause of failure, although it is a common problem, little is known about its causes. If thrombosis occurs within the first 30 days after surgery, it is generally considered to be a surgical problem. They also reported that apart faulty surgical techniques, other reasons such as inappropriate veins, poor arterial flow, age above 65 years and female gender.[16]

There was no statistically accepted difference in incidence of pseudo aneurysm between two methods. All of them were repaired without incidence of rupture. Small pseudo-aneurysm at the sites of repeated punctures generally subsides over time if the overlying skin is intact.[17] There was no significant difference between 2 techniques regarding venous hypertension and hematoma.

CONCLUSION

Radio cephalic autogenously arteriovenous fistulas (RCAVFs) are the first choice for the vascular dialysis. The modified technique of end to side anastomosis can be used to increase patency rate.

This study provides evidence that there is significant reduction in JAS and improvement in AVF maturation using the modified technique, and highlights the role of outflow vein configuration in AVF maturation as minimal alteration of vein wall configuration and avoidance torsion improves AVF maturation.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Ethics Committee of Menoufia University-Faculty of Medicine, Egypt

REFERENCES

1. Saran R, Robinson B, Abbott KC, Agodoa LY, Albertus P, Ayanian J, et al. US renal data system 2016 annual data report: epidemiology of kidney disease in the United States. Am J kidney Dis. 2017;69(3):7-8.
2. Weiss MD, Wasdell MB, Bomben MM, Rea KJ, Freeman RD. Sleep hygiene and melatonin treatment for children and adolescents with ADHD and initial insomnia. J Am Aca Child Adolescent Psy. 2006;45(5):512-9.
3. Konner K, Keller F, Cetto C, Langer S, Hepp W, Thon P, et al. Dialyseshuntchirurgie. Dialyseshunts. Heidelberg: Steinkopff; 2009:119-276.
4. Wang Y, Krishnamoorthy M, Banerjee R, Zhang J, Rudich S, Holland C, et al. Venous stenosis in a pig arteriovenous fistula model-anatomy, mechanisms and cellular phenotypes. Nephrol Dialysis Transplantation. 2007;23(2):525-33.
5. Wong CY, de Vries MR, Wang Y, van der Vorst JR, Vahrmeijer AL, van Zonneveld AJ, et al. A novel murine model of arteriovenous fistula failure: the surgical procedure in detail. J Vis Exp. 2016;(108):e53294..
6. Bharat A, Jaenicke M, Shenoy S. A novel technique of vascular anastomosis to prevent juxta-anastomotic stenosis following arteriovenous fistula creation. J Vasc Surg. 2012;55(1):274-80.
7. Michael A, Michelle LR. Increasing arteriovenous fistulas in hemodialysis patients: problems and solutions. Kidney Int. 2002;62(4):1109-24.
8. Dember LM, Beck GJ, Allon M, Delmez JA, Dixon BS, Greenberg A, et al. Effect of clopidogrel on early failure of arteriovenous fistulas for hemodialysis: a randomized controlled trial. JAMA. 2008;299(18):2164-71.
9. Al-Benna S, Deardon D, Hamilton D, El-Enin H. Long-term outcome of upper limb autogenous arteriovenous fistulas for hemodialysis access. Saudi J Kidney Dis Transplant. 2013;24(1):109.
10. Murphy GJ, Nicholson ML. Autogeneous elbow fistulas: the effect of diabetes mellitus on maturation, patency, and complication rates. Eur J Vasc Endovasc Surg. 2002;23(5):452-7.
11. Ali S, Shahzad I, Baloch MU. Arterio venous fistula experience at a tertiary care hospital in Pakistan. Pakistan J Med Sci. 2013;29(1):161-5.
12. Schinstock CA, Albright RC, Williams AW, Dillon JJ, Bergstralh EJ, Jenson BM, et al. Outcomes of Arteriovenous Fistula Creation after the Fistula First Initiative. Clin J Am Soc Nephrol. 2011;6(8):1996-2002.
13. Huijbregts HJT, Bots ML, Wittens CHA, Schrama YC, Moll FL, Blankestijn PJ. Hemodialysis Arteriovenous Fistula Patency Revisited: Results of a Prospective, Multicenter Initiative. Clin J Am Soc Nephrol. 2008;3(3):714-9.
14. Sadaghianloo N, Declemy S, Jean-Baptiste E, Haudebourg P, Robino C, Islam MS, et al. Radial artery deviation and reimplantation inhibits venous juxta-anastomotic stenosis and increases primary patency of radial-cephalic fistulas for hemodialysis. J Vasc Surg. 2016;64(3):698-706.e1.
15. Sidawy AN, Spergel LM, Besarab A, Allon M, Jennings WC, Padberg Jr FT, et al. The Society for Vascular Surgery: clinical practice guidelines for the

surgical placement and maintenance of arteriovenous hemodialysis access. J Vasc Surg. 2008;48(5):2-25.
16. Radojica S. Most Important Chronic Complications of Arteriovenous Fistulas for Hemodialysis. Med Princ Pract. 2013;22(3):220-8.
17. Woo K, Cook PR, Garg J, Hye RJ, Canty TG. Midterm results of a novel technique to salvage autogenous dialysis access in aneurysmal arteriovenous fistulas. J Vasc Surg. 2010;51(4):921-5.

Cite this article as: Atif H, Zaid NA, Mohamed AEF, Alkhateep YM. Modified technique of end to side distal radio-cephalic shunt to overcome juxta-anastomotic stenosis. Int Surg J 2019;6:1029-34.