Mans. Med. J. Vol. 50. Issue 2, 2021, pages 79-94

Mansoura Medical Journal

(Official Journal of Mansoura Faculty of Medicine)

pISSN: 1110-211X; eISSN: 2735-3990

Use of forearm basilic vein as an option of upper limb vascular access for haemodialysis

By

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DOI : 10.21608/mimu.2021.81651.1019

Submit Date: June 1, 2021
Accept Date : June 30, 2021
Available online: July 30, 2021

Keywords

- Ckd
- Dialysis
- access.

Abstract

in our study , we aimed to evaluate the outcome of forearm basilc vein transposition and anastomosis to either radial or brachial areteries to create arteriovenous fistula for haemodialysis. **Patient and Methods :** This is an observational prospective study conducted from august 2019 to December 2020 at the Department of Vascular Surgery, Mansoura University hospital . 25 patients were selected for forearm basilic vein transposition (FBVT) . 18 cases underwemt BB loop AVF and 7 cases underwent radiobasilic AVF . procedure was done under combined supraclavicular and local xylocaine 1% anaethesia . Basilic vein was harvested using multiple incisions then elevated and anastmosed to either radial artery in 7 cases or tunneled as aloop and anastomsed to brachial artery in 18 cases . **Results**: The mean age of patients who received an AVF was 56.96±9.61 years, with a range of 35 to 70 years, and included 19 men (76%) and 6 women (24%).18 cases underwemt BB looped AVF and 7 cases underwent radiobasilic AVF . patients were followed up for 1 year. 1ry patency rates at 3,6,12 months were 84% ,83.3%,82.6%. **Conclusion**: Radiobasilic or forearm brachiobasilic looped AVF can be used as an alternative option in case of cephalic vein inadequancy or if it was previously used for haemdialysis.

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INTRODUCTION

It is essential to secure and maintain adurable vascular access with minimal risk of complications for proper dialysis in patients on chronic regular hemodialysis. [1]

Autogenous arteriovenous fistulas (AVF) are the preferred mode of vascular access for maintenance hemodialysis (HD) followed by prosthetic grafts and finally central permenant catheters [1, 2,6] .

The Kidney Disease Outcome Quality Initiative (KDOQI) recommends autologous radiocephalic or brachiocephalic AVF as a primary method of choice in HD patients . the basilic vein transposition (BVT) comes as a secondary option in patients with failed radio-cephalic fistula (RCF) or brachiocephalic fistula (BCF) .[3]

Arm brachiobasilic AVF was widely discussed by many groups either by one stage transposition or by two stages . but fewer studies have been discussing FBVT , although its valuable role and relatively old route.[4]

Forearm basilic vein could be used before arm basilic vein transposition, providing another option for autogenous hemodialysis access.[5]

In patients with unfavourable anatomy , a looped transposition of forearm basilic vein (BV) can be created to facilitate more proximal anastomosis with brachial, radial or ulnar artery in the antecubital region.[7]

Patient and methods

This is an observational prospective study conducted from august.2019 to December 2020 at the vascular surgery department , Mansoura University hospitals .

ERDS patients with Cephalic vein inadequacy (upper arm and forearm) which my be Previously used for access or Destroyed by venipuncture or Unsuitable anatomy are considered in our study .

Duplex us of venous system of both upper limbs was examined starting with cephalic vein. In case of inadequate cephalic vein , basilic vein was examined . Forearm basilic vein Diameter which should be >2.5mm in dimater and adequetly distensible with patency throughout its course . Arm basilic vein should also be examined which should be patent with 3mm or more in diameter with adequate distensibility up to axilla .

Color DUS was conducted on Arterial vessels of the arm from axillary to radial and ulnar artery. Arterial vessels examinations consists of evaluating diameter , wall morphology and PSV.

The radial artery in the forearm should be of 2 mm or more in diameter and brachial artery should be of 4 mm or more with no signs of vasculopathy as arterial calcifications and/or stenosis.

When radial artery is suitable to use , basilic vein was transposed and anastmosed to radial artery . in case of unsuitability of radial artery , forearm basilic vein was transposed and tunneled as aloop and anastmosed to brachial artery .

25 patients were selected for FBVT . The mean age of patients who received an AVF was 56.96±9.61 years, with a range of 35 to 70 years, and included 19 men (76%) and 6 women (24%). 3 cases had previous radiocephalic AVF and 2 cases had previous brachiocephalic AVF which were thrombosed . other 20 cases had inadequate cephalic vein .18 cases underwent BB looped AVF . 7 cases underwent radiobasilc AVF . basilic vein diameter in studied cases was 3.06±0.29 mm .

Patients were examined clinically by Allen's test to assess palmar arch patency and arterial pulsations were detected and skin marked .

forearm baslic vein was examined clinicaly under tourniquet to assess patency and its continuity throughout forearm to elbow. Duplex us was conducted on areterial and venous system of both upper limbs with mapping of FBV to confirm patency and size of forearm basilic vein which decreased surgical exposure and dissection times.

Surgical technique :

Preoperative mapping of forearm Basilic vein through physical examination and Doppler ultrasound was mandatory in all cases. All Patients were operated using supraclavicular anaesthesia while 10 patients required combined supraclavicular and local xylocaine 1% anaethesia. We used to perform three or four separate longitudinal skin incisions to dissect FBV from the elbow to the wrist region . Tributaries were ligated using absorbalble vicryl 3/0 sutures . Then basilic vein was ligated and divided distally for its elevation. Then baslic vein was inflated with heparinized saline and thrill was palpated through the vein to ensure its patency .

in 7 patients, radial artery (had adiameter ranging from 2mm to 3.2 mm with no calcifications or stenosis with PSV ranged from 40 to 80 cm/sec) was dissected and exposed above wrist and prepared for anastomosis. A subcutaneous tunnel on the ventral aspect of the forearm was created . then BV was anastomsed end to side to radial artery with polyprolene 6/0 sutures . While in 18 patients, radial artery was unsuitable , brachial artery was examined which had adiameter ranged from 3.5 mm to 5 mm with PSV ranged from 45 to 90 cm/sec . It was exposed at cubital fossa then BV was tunneled subcutaneously as aloop and anastmosed end to side to BA . care was taken to avoid twisting of vein .Vascular bulldog clamp was applied proximally at basilic vein . separate incisions were made to allow transposition of vein while it is inflated with heparinized saline . operative time was approximately 100 min .

Results:

The mean age of patients who received an AVF was 56.96±9.61 years, with a range of 35 to 70 years, and included 19 men (76%) and 6 women (24%).13 DM, 18HTN,4cardiac,4smokers ,9 with hyperlipedemia , 2hepatic, 17 patients were on haemodialysis , 5 patients had previous AVF (3 RCAVF, 2BC AVF).18 cases underwemt BB loop AVF and 7 cases underwent radiobasilic AVF . table 1,2.

Successful maturation occurs in 22 patients. Maturation timing was approximately 44.96 days . 7 cases had radiobasilic AVF . among them one case failed to mature and underwent successful venoplasty . 18 cases had BB loope AVF . among them 2 cases failed to mature . one of them underwent another access (arm BB AVF) .the other one underwent superfiscialization of arm basilic vein . Basilic vein thrombosis was reported after 3months in 1 patient with BB loop and underwent successful thrombectomy.

Death was reported in 2 cases after 4 , 6 months of creation of AVF. 4 cases developed sc edema .they were managed conservatively and edema resolved completely. 3 cases developed seroma at harvesting wound which resolved spontaneously 1 wk later . 2 cases had small hematomas at harvesting wounds . they were managed by hot fomentation and daily dressing . There were no

reported cases of venous hypertension , steel syndrome or infections . table 3,4.

Patency rates:

patients were followed up for 1 year .Regular examination was done at 1,3,6,12 months post operative. 1ry patency rates at 3,6,12 months were 84% ,83.3%,82.6%.

Table 5 , figure 8,9.

1ry patency rate at 12 months was 85.7% for RB AVF and 81.25 % for BB looped AVF .table 10 .

Table (1):demographic characteristics of the studied cases.

	N=25	%
Age/years mean±SD (min-max)	56.96±9.61 (35-70)	
Sex		
Male	19	76.0
Female	6	24.0
Occupation		
Not working	10	40.0
Working	15	60.0

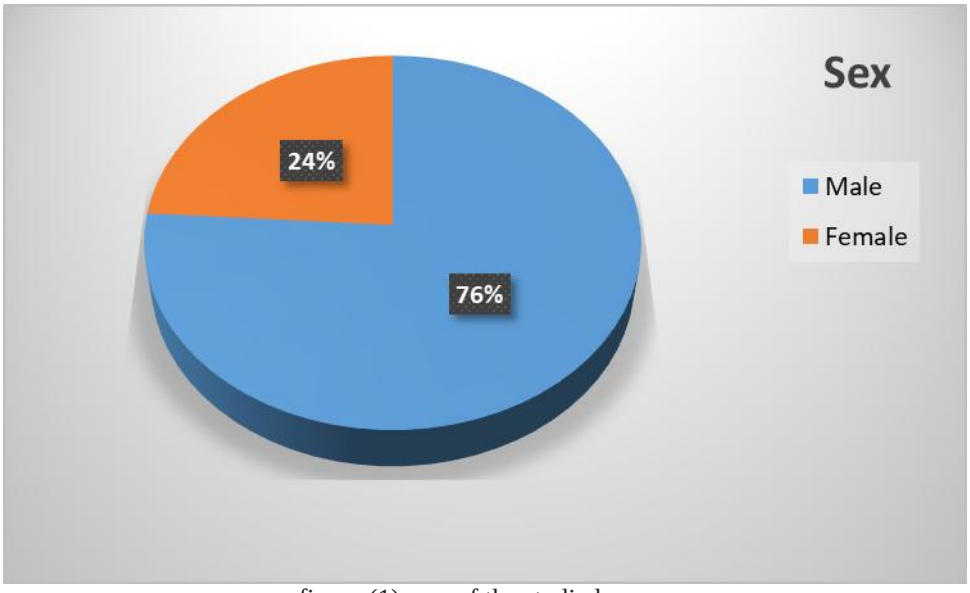


figure (1): sex of the studied cases.

Table (2): medical history of the studied cases.

	N=25	%
DM	13	52.0
Hypertension	18	72.0
Cardiac	4	16.0
Smoking	4	16.0
Hyperlipidemia	9	36.0
Hepatic	2	8.0
Dialysis	17	68.0
Previous Fistula	5	20.0

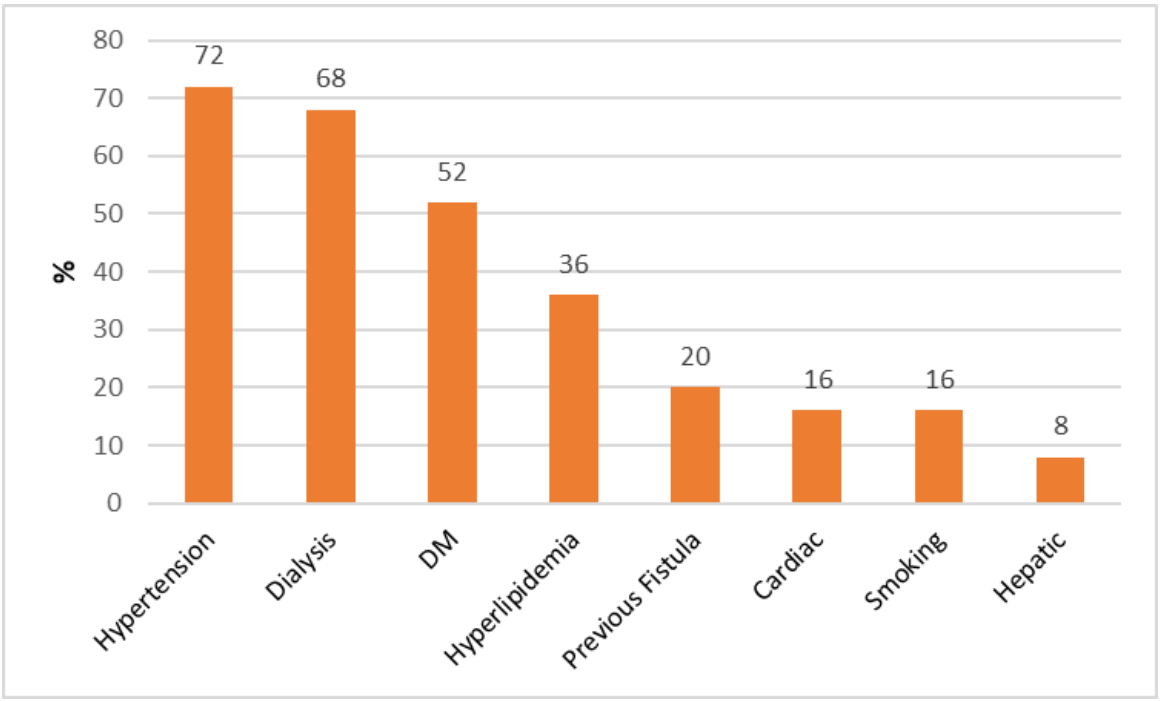


figure (2): medical history of the studied cases

Table (3): Operation characteristics distribution among studied cases

	n=25	**%**
Basilic vein diameter /mm mean±SD (min-max)	3.06±0.29 (2.5-3.6)	
Radiobaslic	7	28.0
Brachiobasilic loop	18	72.0
Operative time/minutes mean±SD (min-max)	98.6±5.87 (90-115)	
Successful maturation timing /days mean±SD (min-max)	44.96±1.36 (43-50)	

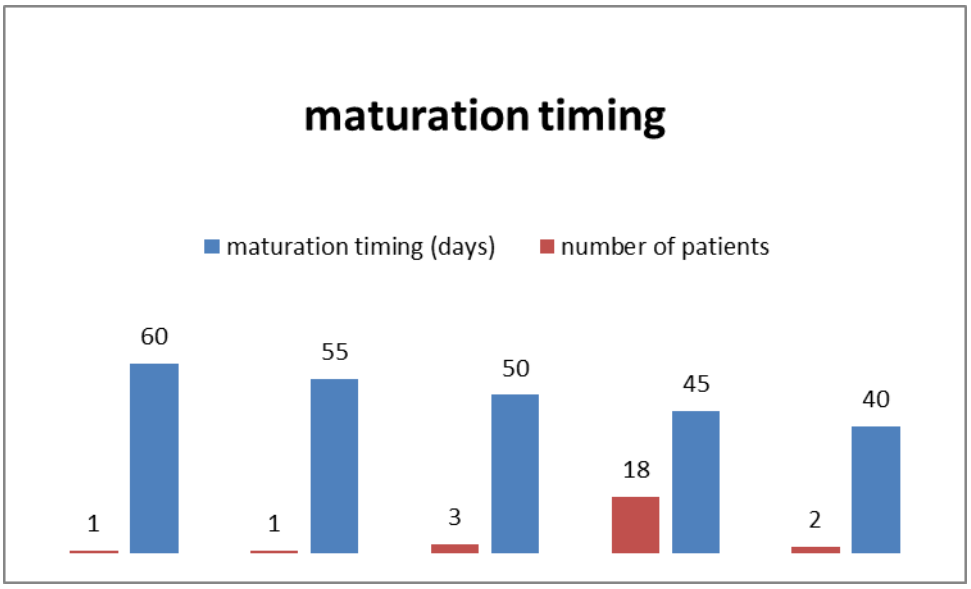


Figure (3) maturaton timing (days)

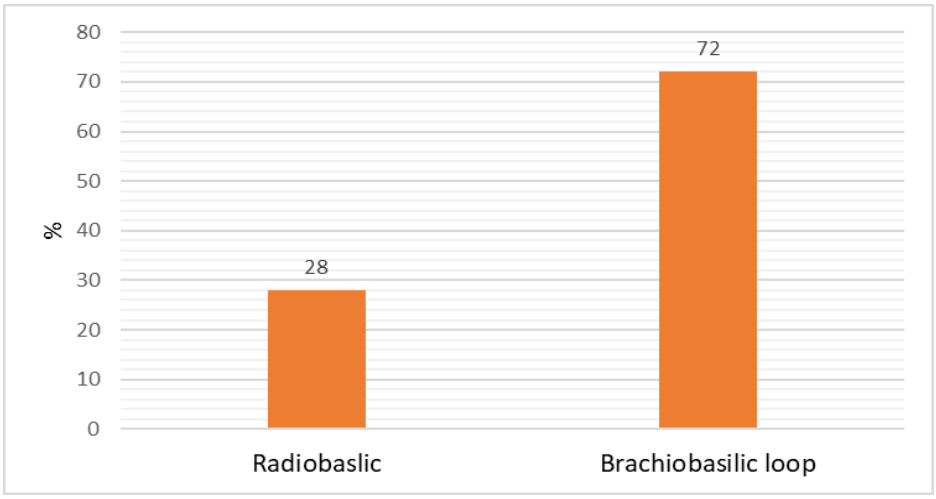


Figure (4) % of RB vs BB loop

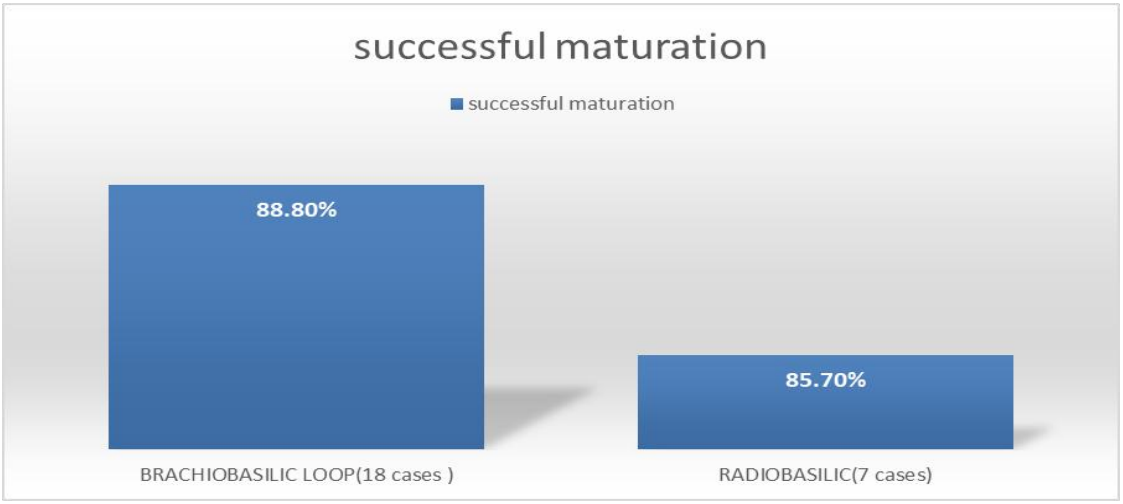


Figure (5) maturation success

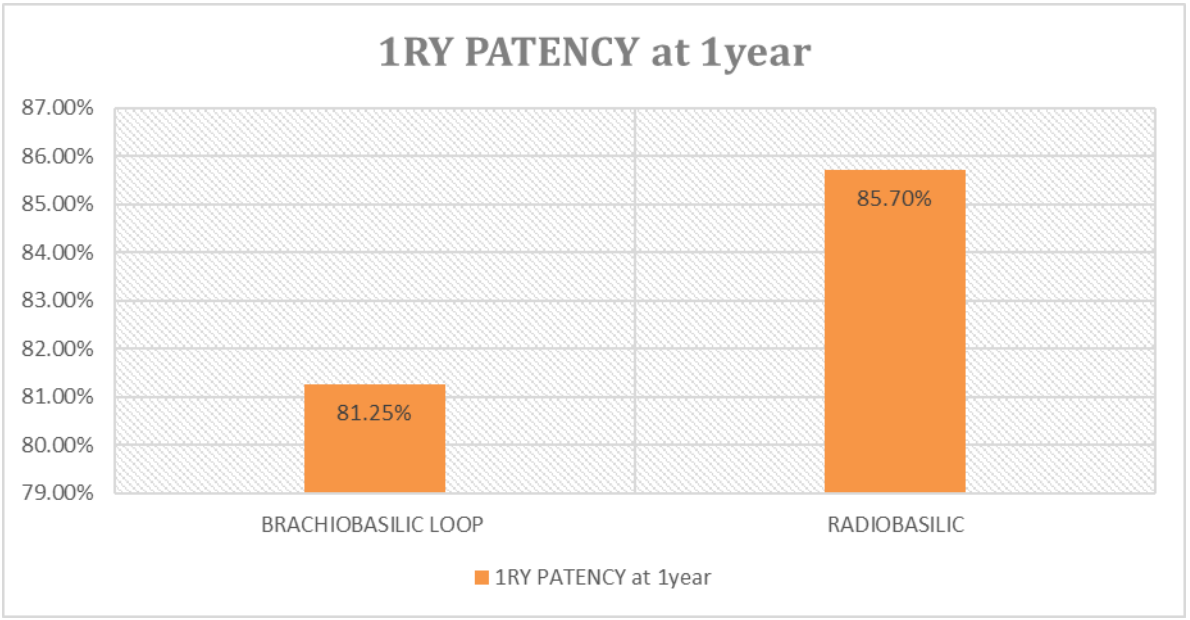


Figure (6) Iry patency rate at 1 year

Table (4): complications distribution among studied cases.

	n=25	%
Infection	0	0.0
Hematoma	2	8.0
Seroma	3	12.0
Thrombosis	1	4.0
SC oedema	4	16.0
Venous HTN	0	0.0
Steal syndrome	0	0.0
stenosis(N=23)	1	4.0
Maturation failure	3	12.0

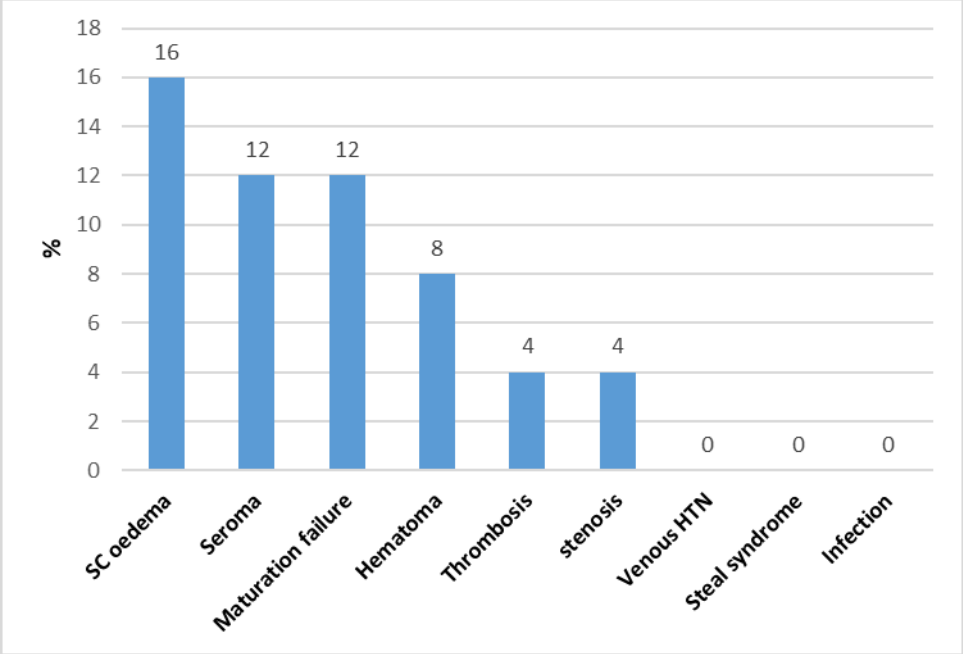


figure (7): complication distribution among studied cases

Table (5): outcome distribution among studied cases.

	n=25	%
Death	2	8.0
Patency at 1m	22	88.0
Patency at 3m	21	84.0
Patency at 6 m (N=24)	20	83.3
Patency at 12 m (N=23)	19	82.6
Intervention venoplasty (N=23)	1	4.3
Superficialization of arm BB (N=23)	1	4.3
Thrombectomy (N=23)	1	4.3
Another access **-VE** **Superficiliazation** **arm BB AVF**	N=23 21 1 1	 91.3 4.3 4.3
Secondary patency **lost access (arm BB AVF)** **Patent**	N=4* 1 3	 25.0 75.0

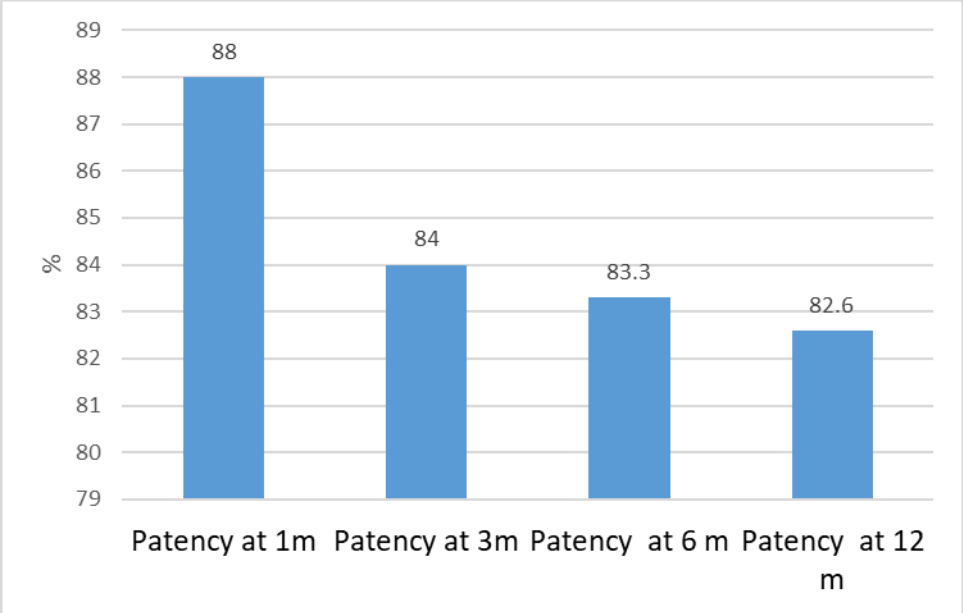


figure (8): patency distribution among studied cases

Table (6): Association between incidence of patency at one month of follow up and studied risk factors among studied cases.

	Total number =25	**Patency at 1m**		**Test of significance**
		-VE n=3	+VE n=22	
Age/years	25	64.0±5.65	56.35±9.71	t=1.08, p=0.289
Sex **Male** **Female**	 19 6	 3(15.8) 0	 16(84.2) 6(100)	FET, P=0.554
Occupation **Not working** **Working**	 10 15	 2(20) 1(6.7)	 8(80) 14(93.3)	FET, P=0.543
DM	13	3(23.1)	10(76.9)	FET, P=0.22
Hypertension	18	2(11.1)	16(88.9)	FET, P=1.0
Cardiac	4	1(25)	3(75)	FET, P=0.422
Smoking	4	0	4(100)	FET , P=1.0
Hyperlipidemia	9	2(22.2)	7(77.8)	FET P=0.53
Hepatic	2	0	2(100)	FET, P=1.0
Dialysis	17	3(17.6)	14(82.4)	FET, P=0527
Previous Fistula	5	0	5(100)	FET, P=1.0
Basilic vein diameter /mm	25	2.55±0.07	3.10±0.267	t=2.87 p=0.009*
Radiobaslic	7	1(14.3)	6(85.7)	FET , P=1.0
Brachiobasilic loop	18	2(11.1)	16(88.9)	FET , P=1.0
Operative time/minutes	25	100±0	98.48±6.11	t=0.345 , p=0.733
Successful maturation timing /days	25		44.96±1.36	
Hematoma	2	0	2(100)	FET, P=1.0
Seroma	3	0	3(100)	FET, P=1.0
Thrombosis	1	1(100)	0	FET , P=0.12
SC oedema	4	0	4(100)	FET , P=1.0
Maturation failure	3	3(100)	0(0)	FET , P=0.01*

FET :Fischer exact test , t :Student t test , *statistically significant if p<0.05

Table (7): Association between incidence of patency at 3 months of follow up and studied risk factors among studied cases.

	Total number =25	**Patency at 3 m**		**Test of significance**
		-VE n=4(16.0%)	+VE n=21(84.0%)	
Age/years	25	65.50±4.04	55.33±9.54	t=2.08, p=0.05
Sex				
male	19	3(15.8)	16(84.2)	FET , P=1.0
female	6	1(16.7)	5(83.3)	
Occupation				
Not working	10	3(30.0)	7(70.0)	FET, P=0.267
Working	15	1(6.7)	14(93.3)	
DM	13	3(23.1)	10(76.9)	FET, P=0.593
Hypertension	18	3(16.7)	15(83.3)	FET, P=1.0
Cardiac	4	2(50.0)	2(50.0)	FET, P=0.106
Smoking	4	0	4(100)	FET, P=1.0
Hyperlipidemia	9	3(33.3)	6(66.7)	FET, P=0.116
Hepatic	2	0(0.0)	2(100)	FET, P=1.0
Dialysis	17	4(23.5)	13(76.5)	FET, P=0.269
Previous Fistula	5	1(20.0)	4(80.0)	FET, P=1.0
Basilic vein diameter /mm	25	2.63±0.125	3.14±0.24	t=4.09, p<0.001*
Radiobaslic	7	1(14.3)	6(85.7)	FET, P=1.0
Brachiobasilic loop	18	3(16.7)	15(83.3)	FET, P=1.0
Operative time/minutes	25	100±0.0	98.33±6.39	t=0.513, p=0.613
Successful maturation timing /days	25	47.50±3.54	44.71±0.845	t=3.33, p=0.003*
Hematoma	2	1(50)	1(50)	FET, P=0.30
Seroma	3	1(33.3)	2(66.7)	FET, P=0.422
Thrombosis	1	1(100)	0(0.0)	FET, P=0.160
SC oedema	4	0	4(100)	FET, P=1.0
Maturation failure	3	3(100)	0	FET, P=0.002*

FET :Fischer exact test , t :Student t test , *statistically significant if p<0.05

Table (8): Association between incidence of patency at 6 months of follow up and studied risk factors among studied cases.

	Total number =24	**Patency at 6 months**		**Test of significance**
		-VE N=4(16.7%)	+VE N=20(83.3%)	
Age/years	**24**	**64.0±5.66**	**55.73±9.46**	t=1.20, p=0.242
Sex				
Male	19	3(15.8)	16(84.2)	FET, P=1.0
Female	5	1(20)	4(80)	
Occupation				
Not working	10	3(30)	7(70.0)	FET, P=0.272
Working	14	1(7.1)	13(92.9)	
DM	12	3(25)	9(75)	FET, P=0.590
Hypertension	17	3(17.6)	14(82.4)	FET, P=1.0
Cardiac	4	2(50)	2(50)	FET, P=1.0
Smoking	4	0	4(100)	FET, P=1.0
Hyperlipidemia	8	3(37.5)	5(62.5)	FET, P=0.09
Hepatic	2	0(0.0)	2(100)	FET, P=1.0
Dialysis	16	4(25.0)	12(75.0)	FET, P=0.262
Previous Fistula	5	1(20)	4(80)	FET, P=1.0
Basilic vein diameter /mm	24	**2.55±0.07**	**3.10±0.27**	t=2.79, p=0.01*
Radiobaslic	7	1(14.3)	6(85.7)	FET, P=1.0
Brachiobasilic loop	17	3(17.6)	14(82.4)	FET, P=1.0
Operative time/minutes	24	**100±0.0**	**97.73±5.05**	t=0.623, p=0.540
Successful maturation timing /days	24		**45.05±1.33**	…….
Hematoma	2	1(50)	1(50)	FET, P=1.0
Seroma	3	1(25)	2(75)	FET, P=0.437
Thrombosis	1	1(100)	0(0.0)	FET, P=0.167
SC oedema	3	0	3(100)	FET, P=1.0
Maturation failure	3	3(100)	0(0.0)	FET, P=0.002*

FET :Fischer exact test , t :Student t test , *statistically significant if p<0.05

Table (9): Association between incidence of patency at 12 months and studied risk factors among studied cases.

	Total number =23	Patency at 12 months		Test of significance
		-VE N=4(17.4%)	+VE N=19(82.6%)	
Age/years	**23**			t=1.20, p=0.242
Sex **Male** **Female**	 18 5	 3(16.6) 1(20.0)	 15(83.3) 4(80)	FET, P=1.0
Occupation **Not working** **Working**	 10 14	 3(30) 2(14.3)	 7(70.0) 12(85.7)	FET, P=0.615
DM	12	4(33.3)	8(66.7)	FET, P=0.317
Hypertension	17	4(23.5)	13(76.5)	FET, P=1.0
Cardiac	4	2(50)	2(50)	FET, P=1.0
Smoking	4	1(25)	3(75)	FET, P=1.0
Hyperlipidemia	8	4(50)	4(50)	FET, P=0.028*
Hepatic	2	0(0.0)	2(100)	FET, P=1.0
Dialysis	16	4(25.0)	12(75.0)	FET, P=0.262
Previous Fistula	5	1(20)	4(80)	FET, P=1.0
Basilic vein diameter /mm	23	**2.55±0.07**	**3.10±0.27**	t=2.79, p=0.01*
Radiobaslic	7	1(14.3)	6(85.7)	FET, P=1.0
Brachiobasilic loop	16	3(18.75%)	13 (81.25%)	FET, P=1.0
Operative time/minutes	23	**100±0.0**	**97.73±5.05**	t=0.623, p=0.540
Successful maturation timing /days	23		**45.05±1.33**	…….
Hematoma	2	1(50)	1(50)	FET, P=1.0
Seroma	3	1(33.3)	2(66.7)	FET, P=0.521
Thrombosis	1	1(100)	0(0.0)	FET, P=0.208
SC oedema	3	0	3(100)	FET, P=1.0
Maturation failure	3	3(100)	0(0.0)	FET, P=0.005*

FET :Fischer exact test , t :Student t test , *statistically significant if p<0.05

Table(10): Association between incidence of patency at 12 months and studied risk factors among RB and BB looped AVF

	Total number =25			Test of significance
Maturation failure	3	2(11.1)	1(14.3)	FET P=1.0
basilic.vein.diameter.MM		3.10±0.30	2.95±0.28	t=1.08 p=0.292
operative.time.min		100.83±4.62	92.85±4.87	t=3.82 p=0.001*
successful_maturation_timing		44.56±0.89	45.86±1.86	t=2.28 p=0.03*
SC oedema	4	2(11.1)	2(28.6)	FET P=0.548
Hematoma	2	2(11.1)	0	FET P=1.0
Seroma	3	2(11.1)	1(14.3)	FET P=1.0
Thrombosis	١	1(5.6)	0	FET P=1.0
Primary patency at 12 months	19	13(81.25)	6(85.7)	FET P=1.0
Intervention venoplasty	1	0	1(14.3)	FET P=1.0
Superficializing of arm BB	1	1(5.6)	0	FET P=1.0
Thrombectomy	1	1(5.6)	0	FET P=1.0
Another access **0** **superficialization** **arm BB AVF**	 23 1 1	 16(88.9) 1(5.6) 1(5.6)	 7(100) 0 0	MC P=0.655

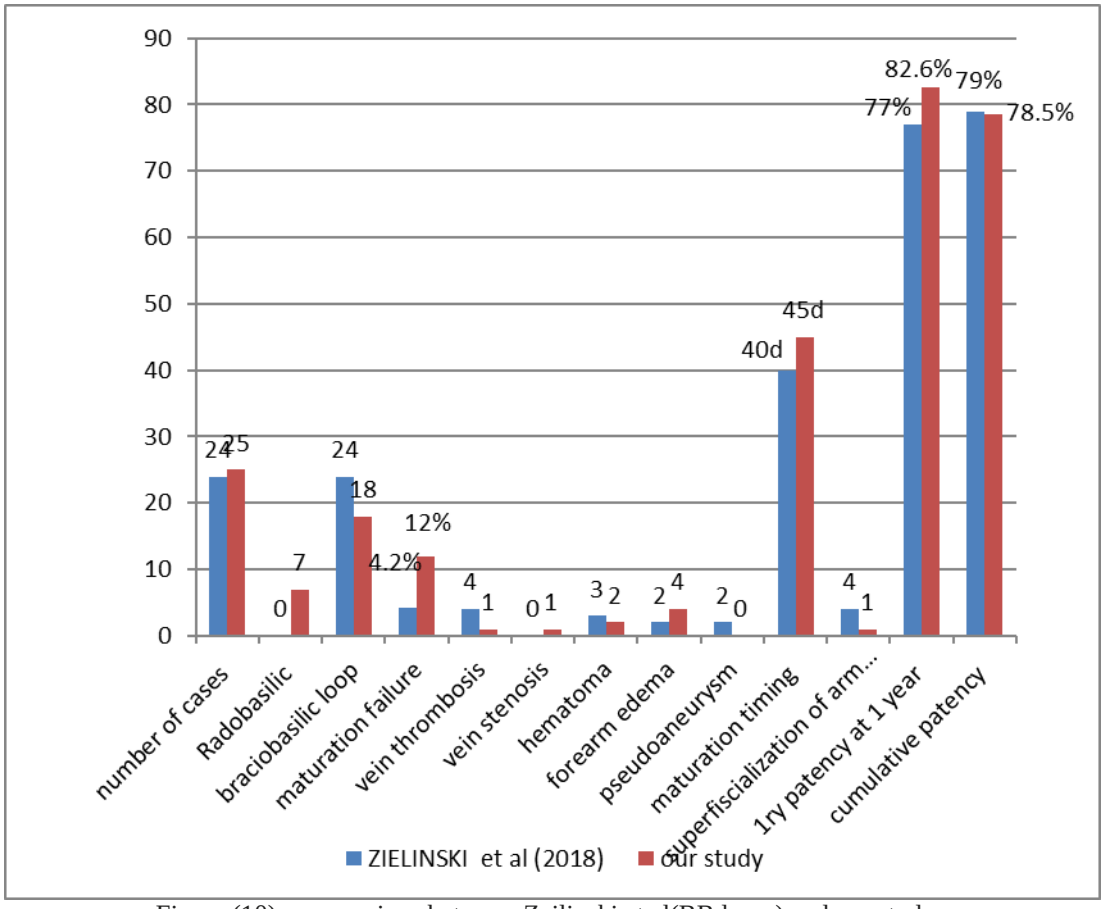
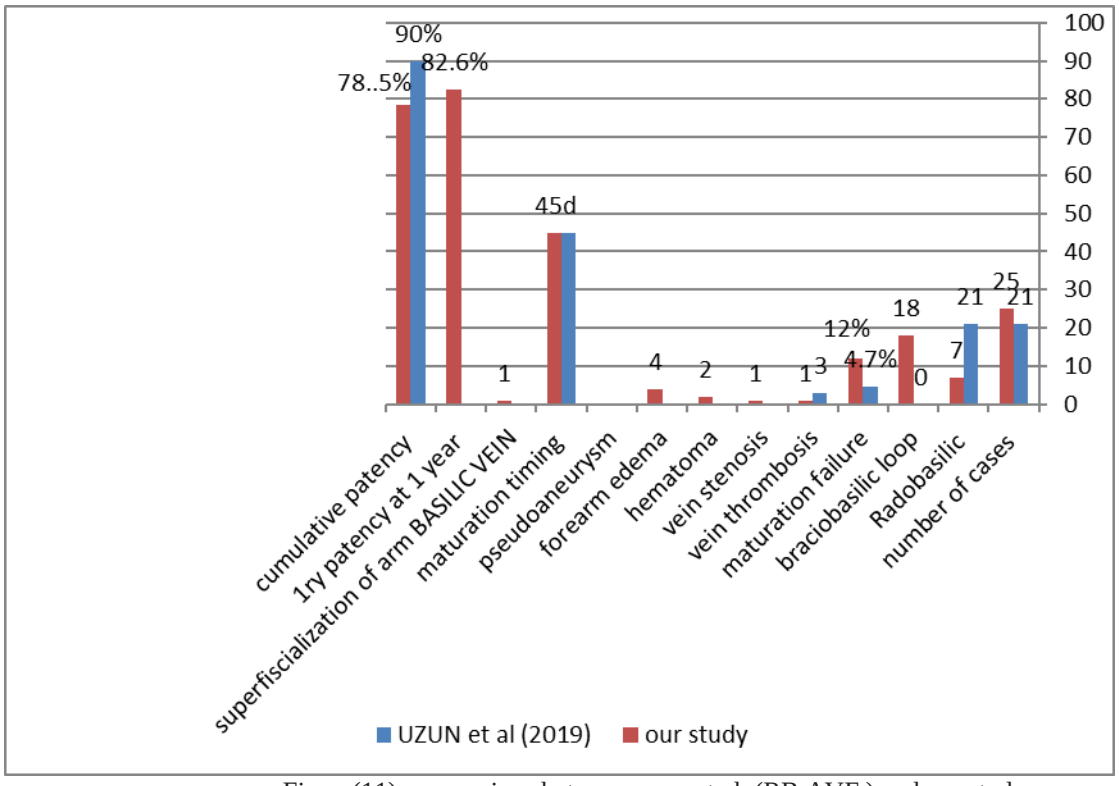


Figure (10) : comparison between Zeilinski et al(BB loop) and our study .



Figure(11): comparison between uzun et al.,(RB AVF) and our study

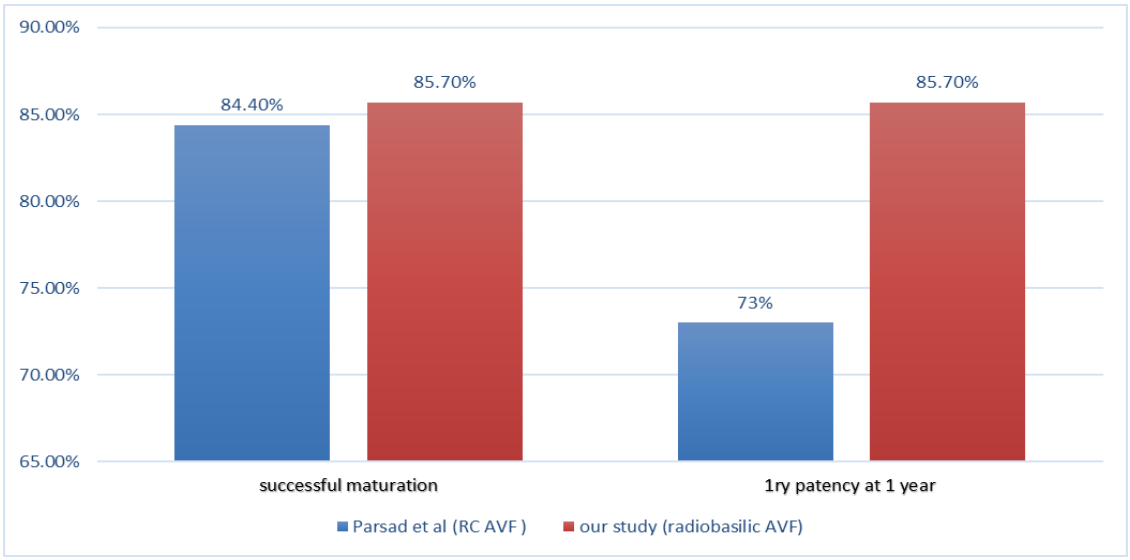


Figure (12) : RC AVF (parsad et al.,) and our RB AVF.

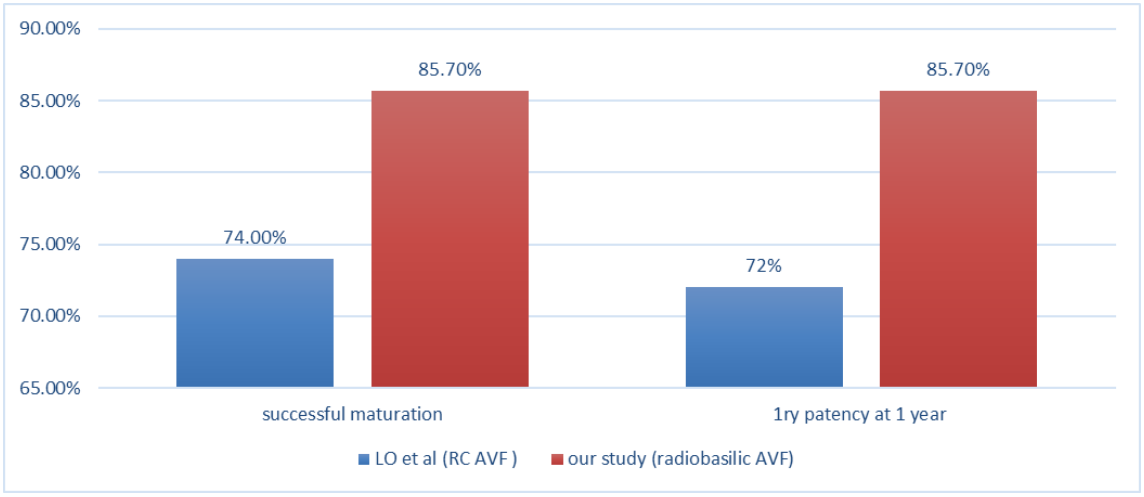


Figure (13) : RC AVF (lo et al.,) and our RB AVF

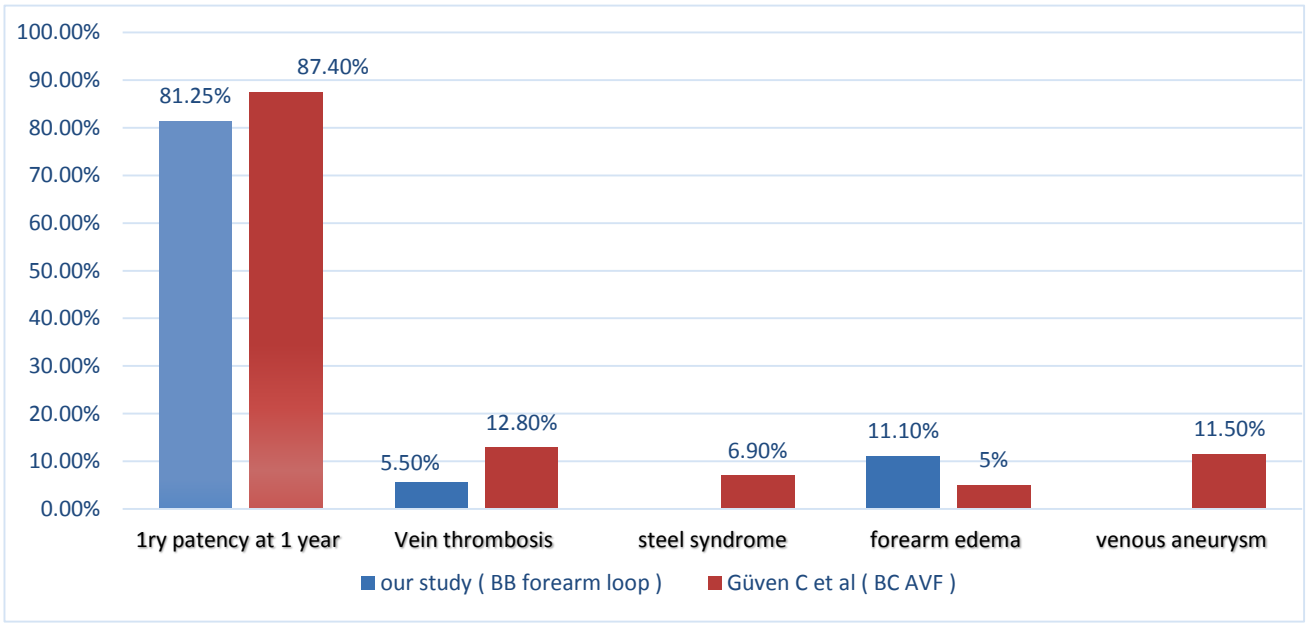


Figure (14) : our study (BB loop) and Guven c et al (BC AVF).

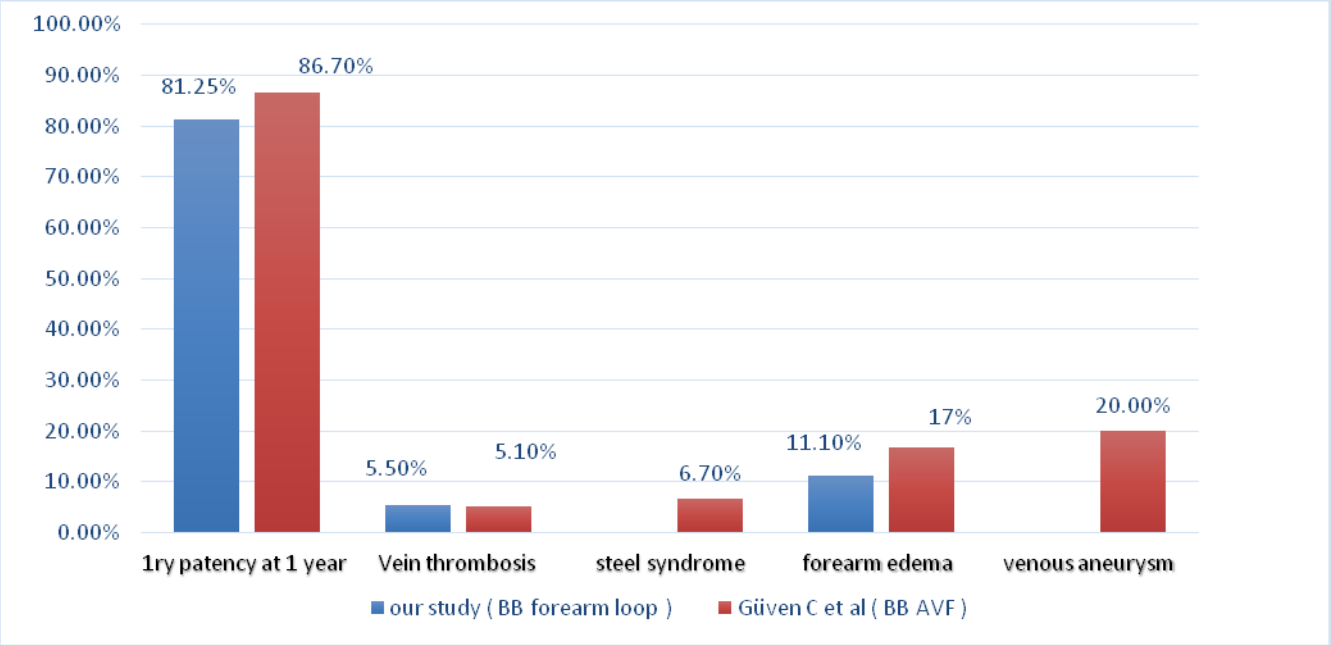


Figure (15) : our study (BB loop) and Guven c et al (BB AVF).

DISCUSSION :

it is recommended as Class I indication that patients with a glomerular filtration rate less than 30 mL/min/1.73 m2 (Stage 4 chronic kidney disease) should be referred to vascular surgeon for creating haemodialysis access. Therefore, creation of adialysis access should be performed three to six months before initial time of hemodialysis.[8]

It has been proved that autogenous conduits for hemodialysis are more advantageous compared to prosthetic access as they have improved patency rates and lower risk of infection.[9]

Radiocephalic (RC) fistulae remain the first choice access for hemodialysis. The antecubital fossa is recommended as the next site. However, in some patients, forearm basilic vein can be used to create an AVF . As it is rarely used for venipunctures or intravenous lines due to its posteromedial location. Scaring and fibrosis are only found occasionally.[10]

Necessary evaluations which must be performed before placement of a permanent hemodialysis access include physical examination and Duplex USG of the upper extremity arteries and veins.

Arm basilic vein transposition either by one or two stages was discussed and considered as a standard operation for autogenous access, which is often available and kept away by its deep medial position from vein punctures.

BV transposition in the forearm can be a valuable option, specially for secondary AVFs. It can be a better option before brachiocephalic AVF in extremely obese patients if its diameter greater than 2.5 mm and has an adequate length allowing us to use it as an AVF tract.[11]

Compared to similar studies , Zeilinski et al , they performed 24 cases with BB loop AVF . maturation failure occurred in 4.2% of cases . 4 cases had vein thrombosis . 3 had hematomas . 2 cases developed forearm edema and 2 patients had venous pseudoaneurysm. Maturation timing was approximately 40 days .4 cases needed superfiscialization of arm basilic vein . 1ry patency rate at 1 year was 77% while 2ry patency rate was 81% . figure 10.

Compared to Uzun HA et al , they performed 21 cases with radiobasilic AVF . maturation faire was

reported in 4.7 % .3 cases had vein thrombosis . maturation timimg was approximately 45 days . overall patency rates was 90 % . figure 11.

Literature show similar patency rates and complications between forearm basilic vein transposition and distal RC AVF. As for example : Parsad et al ., reported successful maturation of RC AVF as 84.4 %. While 1ry patency rate was 73 % at 1 year .[12] LO et al., had Retrospective review of 436 RCAVFs created between 2009 and 2013. 1ry patency rate of studied cases were 72 %.[13]

In our study 85.7 % of patients with RB AVF achieved successful maturation and patency at 1 year is 85.7 % . figure 12 ,13.

In Literature Arm AVF (BC , BB AVF) have similar patency rates but less operative time and more complications compared to BB loop AVF .

Guven C et al., reported 1ry patency of BC AVF and BB AVF at 1 year as 87.4 % 86.7% consecutively .[14] in our study 1ry patency rate of BB looped AVF is 81.25% . However incidence of steel syndrome ,venous aneurysms and venous thrombosis were higher in patients with BC and BB AVFS than BB looped AVF . figure 14,15.

A lot of procedures have been developed to create functional and long-standing vascular access. The FBVT approach has remarkable features: It has similar results to distal AVFs so we can preserve proximal veins for future use .we can avoid more complex choices.

FBVT has similar complication rates compared to radiocephalic AVFs as regarding maturation failure,thrombosis, infection, rupture AVF or steel syndrome.

FBVT approach provide suitable place for cannulation, as well as offering more comfort with less steal syndrome than arm brachiobasilic AVFs.

Dissection of forearm basilic vein requires multiple incisions in the forearm compared to distal or proximal AVF which usually are performed using single incision . However wound healing was achieved appropriately with no major complications . forearm edema ,harvesting wound seromas and hematomas can occur following dissection and they can be managed conservatively . Supraclavicular , local and even general anaesthesia may be needed in FBVT . FBV dissection often requires more time than other AVFs .

Conclusion :

The forearm basilic vein transposition represents avaluable option for autogonous AVF. the transposition of FBV and anastomosis to the radial or brachial artery represents an additional option for selected patients. According to our study FBVT is a tech-nically feasible and very effective surgical procedure for the creation of durable access for haemodialysis, particularly in patients with cephalic vein inadequacy .

We recommend utilization of forearm basilic vein either radiobasilic or looped BB as avaluable vascular access in case of inadequate cephalic vein preserving proximal veins for future use, delaying usage of prosthetic grafts and avoiding more complications.

Statistical analysis and data interpretation:

Data were fed to the computer and analyzed using IBM SPSS Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. Qualitative data were described

using number and percent. Quantitative data were described using mean, standard deviation for parametric data after testing normality using Kolmogrov-Smirnov test. Significance of the obtained results was judged at the (0.05) level.

Data analysis

Qualitative data :

- Fischer Exact test was used as correction for Chi-Square test when more than 25% of cells have count less than 5 in 2*2tables

Quantitative data between groups:

Parametric tests:

- Student t-test was used to compare 2 independent groups

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