

*Research Article***Role of color Doppler ultrasonography in evaluation of the arteriovenous fistulae in patients with renal failure****Ahmed Abdelrady, MD., Mohamed Alsagheer, MD. and Mohamed Abdallah MBBCH**

Department of Radiodiagnosis, faculty of medicine, AlAzhar university, Assiut , Egypt

**Abstract**

**Objectives:** The aim of this study is to evaluate the role of color Doppler ultrasound in vascular mapping in haemodialysis arteriovenous fistula (AVF), Assesses the process of normal hemodynamics of AVF and evaluation of possible shunt complications. **Material and methods:** Thirty patients were selected either planning for AVF creation or already having AVF for hemodialysis, 10 patients were referred for preoperative planning for fistula creation, The same 10 patients with preoperative planning referred for assurance and confirmation of adequate AVF maturity, and 20 patients with shunt complications . All patients were subjected to:- Verbal and written consents were taken from the patients or their relatives ,Careful history taking regarding clinical state to confirm the clinical data reported in referral request, Local examination. Laboratory investigations including: Serum Urea and Creatinine and Duplex-Doppler sonography of the upper limb. **Results:** according to group 1 who referred for ultrasound planning and maturation assessment it was found that the 3 cases (30%) showed blood flow volume with normal range (300-800ml/min.), 3 cases (30%) showed ideal blood flow volume (average reading was 370 ml/min), 2 Cases (20%) had blood flow volume less than 200ml/min and this considered failed vascular access, 1 case (10%) showed blood flow volume between (2000 to 5000) ml/min, still without clinical problems and 1 case (10%) had blood flow volume over 5000 ml/min with cardiac symptoms according to Group II of detection of shunt complications 20 patients with complicated AV haemodialysis access were thrombosis was seen in 8 cases representing 40% of cases, Infection was seen in 3 cases representing 15 % of cases , Aneurysm was seen in 3 case representing 15 % of cases, High Cardiac Output failure was seen in 3 case representing 15% of cases. Stenosis was seen in 2 case representing 10% of cases. Arterial steal was seen in I case representing 5% of cases. **Conclusion:** Combined CDS and Doppler flow assessment will ultimately become the ideal imaging for haemodialysis access routes, Routine serial sonographic examination can detect complications early enough to improve fistula survival and decrease patient morbidity.

**Key words:** Color Doppler ultrasonography, arteriovenous fistulae, renal failure**Introduction**

End stage renal disease (ESRD) is one of the leading causes of morbidity worldwide especially after the prevalence of diabetes mellitus. In Europe and North America 80-95% of patients with ESRD requiring dialysis are treated with haemodialysis, indicating that peritoneal dialysis is underutilized<sup>(1)</sup>. Increasing numbers of patients that undergoing haemodialysis as a result of end-stage renal disease let maintenance of adequate functioning vascular access one of the challenges of long term haemodialysis. Arteriovenous fistulas (AVFs) remain the access type of choice but synthetic arteriovenous grafts are also used<sup>(2)</sup>. The

introduction of hemodialysis has prolonged the lives of patients with end-stage-renal disease (ESRD). To maintain them on long-term dialysis, vascular access procedures are required<sup>(3)</sup>. It is recommended by Kidney Dialysis Outcomes Quality Initiative (KDOQI) that arteriovenous fistulas (AVFs) are the preferred primary access for haemodialysis, especially autogenously fistulas as it offer several advantages over arteriovenous non autogenous grafts (AVGs) and tunnelled central venous catheters. Overall, autogenously AVFs are associated with superior patency of 75% at 4 years, fewer revisions, lower costs for maintenance, fewer complications, and lower

mortality compared with non autogenously AVGs and catheters<sup>(4)</sup>. Several imaging modalities are available for the evaluation of dysfunctional haemodialysis shunts Color

### Patients and method

Thirty patients were selected either planning for AVF creation or already having AVF for haemodialysis; they were referred from Nephrology, Haemodialysis and Vascular surgery units to the Department of Radiology Al-Azhar University Hospital. Their age ranged from (20) to (70) years. The patients population consists of (11) males and (19) females. All patients were subjected to:- Verbal consent was taken from the patients or their relatives. Careful history taking regarding clinical state to confirm the clinical data reported in referral request. Local examination. Laboratory investigations including: Serum Urea and Creatinine and . Duplex-Doppler sonography of the upper limb. *History taking and clinical examination include* Age, Sex, Duration since fistula application, Number of previous failed fistulae, Associated morbidity (DM, HTN, etc), Oedema, Local pain, Swellings, Local examination including Palpation (For presence of thrill denoting free flow through the shunt). History of local complications, e.g.: Local infection, skin color changes.

### Results

Thirty patients from Hemodialysis, Vascular surgery and Nephrology units presented to the

Doppler unit of the Radiology Department (RD) of Al-Azhar University Hospitals from October 2017 to July 2018 with renal failure and on hemodialysis.

In our study, the most clinical presentation or most likely referral criteria were scheduled for each group. Group I, were referred for pre-operative planning, group II for assessing maturity and group III were referred for assessing complications: either for difficulty in fistula cannulation necessitating several attempts for adequate blood flow, frequent prolonged bleeding after cannulation, pain, edema, or reduced shunt flow by palpation or auscultation

#### *Table showing the frequent referral criteria for each category*

In our study the most frequent types met were the radiocephalic (Bracia-Cimino) hemodialysis access, which is seen in 17cases representing (56.7%) of total cases of the study, followed by Brachiobasilic (BB) shunt in 7 cases representing (23.3%) then Brachiocephalic AVF in 4 cases (13.3%) and lastly Brachiobasilic loop graft (Polytetrafluorethylene), in 2 cases ( 6.6%)

Frequent Referral criteria	No. of patients	Percentage %
<b>I. Preoperative planning and follow up</b>	10	33.3
<b>III. Assess complications:</b>		
<b>(1) Difficulty in fistula cannulation.</b>	9	30
<b>(2)Pain and edema.</b>	4	13.3
<b>(3)Frequent prolonged bleeding.</b>	3	10
<b>(4)Reduced shunt flow by palpation or auscultation</b>	4	13.3

### Discussion

Standard techniques for assessing AVF anatomy and flow have major limitations. Clinical assessment, and pulsed-wave Doppler without ultrasonographic imaging do not provide sufficient anatomical information.

Angiography is an invasive technique, so it cannot be frequently repeated and can be associated with discomfort and potential fistula injury .In our study, The number of the patients with preoperative CDU assessment was 10 cases (33.3%) from the total number of cases of

the study. In our study, the mean diameter of the cephalic vein measured preoperatively was 2.6 mm at the wrist, 3.0 mm in mid-forearm and 3.2 mm at the elbow, The mean diameter of the basilic vein 2.5 mm at the wrist and 2.8mm at the forearm and 2.8mm at the arm. The radial artery was generally smaller, with mean diameter of 2.2 mm and with arterial resistance index <0.7. In our study, The number of the patients that assess maturity was the same 10 cases (33.3%) from the total number of cases of the study. In our study a minimum venous diameter of 0.4 cm was accompanied with adequate fistulae. Women are less likely to achieve a minimum venous diameter of 0.4 cm, a finding consistent with prior observations of inferior fistula outcomes among women. This may be in part due to smaller vessels in women. The ability to maintain adequate blood flow during hemodialysis is another crucial determining factor in AVF maturity. In our study, The number of the patients with possible shunt complications was 20 cases (67%) from the total number of cases of the study. In our study, access thrombosis accounted for 40% of access malfunctions, while infection was the second frequent access complication (15%) and Stenosis was seen in 2 cases accounted for 10% of cases. Aneurysmal dilatation was seen in 3 case accounted 15% of cases and the high cardiac output failure which accounted 15% of cases. Arterial steal is least frequent complications which accounted 5 % cases.

### Conclusion

In conclusion, CDS is a non invasive technique that allows the assessment of both anatomy and hemodynamic of an AVF. This technique is free of any known risk, cheap and can be used at the bedside. CDS outlines the AVF lumen and allows definition of lumen dimensions and detection of luminal encroachment. The technique also provides important information to the surgeon, thereby potentially increasing the number of AVF reconstruction rather than new shunts. Combined CDS and Doppler flow

assessment will ultimately become the ideal imaging for HD access routes. Routine serial sonographic examination can detect complications early enough to improve fistula survival and decrease patient morbidity. Most major complications can be repaired without limb loss and with shunt salvage. DUS play a major diagnostic role in comprehensive evaluation of possible shunt complications, its possible causes and differential diagnosis.

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