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Endovascular Management of Central Venous Stenosis in Haemodialysis Patients

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Abstract

Aim of Study: Is to evaluate the patency of the endovascular management for the venous hypertension in haemodialysis access patient having upper limb AVF.

Patients and Methods: Fifty patients were recruited in this study, sixty percent of the patients were females, while 40% of patients were males. Mean age of patients was 47.77 ± 10.49 years. The AVF were native in 38 patients (76%) while synthetic AVFs were reported in 12 cases (24%). Sixty four percent of the patients had left sided AVF & the remaining 36% had right sided AVf. Patency rates of collectively 34 patients are 100%, 97%, 70% at 3, 6, 12 months respectively.

Results: Follow-up of a total of 34 successful cases after one year period revealed 24 cases were free of symptoms while 10 cases had recurrent symptoms. One year patency rate of cases with single lesion was 91.6%, and those with multiple lesions was 8.3% and that was statistically significant. One year patency rate for patients with lesions less than 3cm was 66.6% and for those with lesions more than 3cm was 33.3%. This was statistically insignificant with p=0.1.

Conclusions: Percutaneous central venous angioplasty could provide symptomatic relief in patients that present with central venous stenosis and upper-extremity edema. Complications from PTA are infrequent. It offers a minimally invasive, first-line approach for a difficult problem in a patient population with significant comorbidities. However the durability of PTA is limited, and in most patients additional interventions are required to extend the symptom free period.

Key Words: *Central venous stenosis and occlusions – Haemodialysis – Percuataneous transluminal angioplasty.*

Introduction

CENTRAL veins stenosis or occlusion in dialysis patients is a serious issue, and it has a greater impact compared with stenosis of a peripheral vein because the central veins represent the final common pathway for blood flow from the periphery to the heart. If central stenosis is allowed to progress, the arteriovenous haemodialysis access may eventually be lost [1].

Dialysis vascular access planning, creation, and management are critical in allowing realization of the ESRD patient's longevity potential. This process is best carried out using a multidisciplinary approach which involves the patient and his/her family, the nephrologist, the dialysis facility personnel, the surgeon, and the interventionalist [2].

When an ipsilateral arteriovenous shunt is placed, venous hypertension may be manifested by arm swelling and pain. The optimal treatment of Symptomatic Venous Obstruction (SVO) is still controversial. Ligation of the AVF with the creation of a new access site will usually provide symptomatic improvement. However, as the life expectancy of patients with ESRD increases, additional access sites may no longer be available. For this reason, the general recommendation has been to preserve each shunt for use as long as possible [3].

Endovascular treatment with angioplasty or stenting for central venous stenosis is safe, with low rates of technical failure, less invasive, less hospital stay. In central venous angioplasty the complications are not common; the patients' discomfort in the site of balloon insufflation may be reduced with sedatives. Occasionally, local complications caused by the wide introducers may occur. Such complications are reduced by using

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Abbreviations:

IH : Intimal Hyperplasia.
CVC : Central Venous Catheter.
PTA : Percuataneous Transluminal Angioplasty.

the transfemoral access. Vessel rupture occurs only very rarely. Stent migration, pseudoaneurysm in the site of the stent or a significant stent shortening immediately after insertion or several weeks or even months later have not been manifested in some patients [4].

Subjects and Methods

This study was carried out prospectively in Vascular Surgery Department, Assiut University Hospital (AUH), Assiut, Egypt between May 2015 to May 2016. The study was approved by the ethics committee of AUH. Patients or relatives of patients with chronic renal failure provided written consent for study participation.

Inclusion criteria:

- Upper limb fistula either native or synthetic complicated by venous hypertension which is presented by.
- Edema of the arm, face and breast of the affected side.
- Painful hand ulcerations.
- Aneurysmal dilation and tortuosity of AVF.
- Prolonged bleeding from needle sites after dialysis.
- Duration of symptoms up to 3 months.

Exclusion criteria:

- Age below 18 years old or above 60 years old.
- Duration of symptoms longer than 3 months.
- Lower limbs AVFs.
- Patients that have peripheral vein stenosis.
- Congenital central veins anomalies.
- Mediastinal syndrome patients.

Data were collected from the studied patients as:

- The demographic data such as age, sex, and comorbid diseases as DM & HTN.
- Clinical data: Side of AVF either right or left, duration of the AVF, duration of the presenting symptoms, edema of the arm, face and breast of the affected side, painful hand ulcerations, aneurysmal dilation and tortuosity of AVF, prolonged bleeding from needle sites after dialysis, previous history of CVC insertion, their number and duration and complications either thrombosis or infection, previous history of any prior endovascular intervention.
- Signs of venous hypertension: Edema of the affected limb, breast and face, development of arm and upper chest dilated veins, hand ulcerations, type of AVF; native or synthetic, site of AVF either radiocephalic, brachiocephalic or basilic vein transposition.
- Data from the laboratory investigations were obtained ascomplete blood picture, prothrombin time and concentrations, serum creatinine level, blood urea nitrogen.
- *Data from the imaging studies as:*
  - Duplex scan of the central venous system to show the site and nature of lesion, an absence of normal respiratory variation in the diameter of central veins and polyphasic atrial waves. It is difficult to visualize the central veins with duplex ultrasound in patients with an elevated body mass index, or significant chest musculature.
  - MSCT venography which is more accurate method to assess patency of superficial and deep systems including the central veins.
- Data from treatment options as technical success, stenting or not, type of stent used, residual stenosis and intraoperative complication.

Follow-up of the patients: Regular follow-up of the patients after the dilatation either clinically and radiologically was advised for better correlation of the study for early detection of recurrence of the problem and determination of exact time of primary patency along every 3, 6, 12 months.

All patients fulfilled the study criteria gave an informed consent and the study was approved by the Assiut Faculty of Medicine Ethics Committee with no conflicts of interests to declare by the authors.

Statistical analysis:

Statistical analysis was performed using Windows Version 20.0 (SPSS; SPSS Inc., Chicago, Illinois, USA). Categorical variables were reported as numbers with percentages. Continuous variables were reported as means with standard deviation. Chi-square test was used to compare qualitative data between different groups. All p-values <0.05 were considered significant.

Results

The study included 20 (40%) males and 30 (60%) females with a mean age of 47.77 ± 10.49 years (range: 22-70 years). Hypertension was risk factor in 54% of patients (Table 1).

Table (1): Demographics and comorbidities of the studied group.

	No. (n=50)	%
Age: (years):		
<50	36	72
≥50	14	28
Mean ± SD (range)	47.77±10.49 (22.0-72.0)	
Sex:		
Male	20	40
Female	30	60
Comorbidities:	N=50	%
HTN	27	54
DM	12	24
RHD	1	2
None	12	24

The AVF were native in 38 patients (76%) while synthetic AVFs were reported in 12 cases (24%). Sixty four percent of the patients had left sided AVF & the remaining 36% had right sided AVF. Brachiocephalic AVF were recorded in 44% of cases, 24% of patients with upper limb basilic vein transposition and 8% with upper limb radiocephalic AVF as in (Table 2).

Table (2): Characters of the AVF.

	No. (n=50)	%
Type of AVF:		
Native	38	76
Synthetic	12	24
Side:		
Right	18	36
Left	32	64
Site of AVF:		
UL brachiocephalic	22	44
UL graft	12	24
UL radiocephalic	4	8
UL basilic vein transposition	12	24

The lesions were most commonly located in the innominate vein. It was involved in 32 (64%) of patients followed by the subclavian vein in 10 (20%) of patients, the axillary vein in 11 (22%), and superior vena cava in 4 patients. Regarding the nature of the lesions of central veins, stenosis was recorded in 80% of the patients and the remaining 20% were occlusive in origin.

Table (3): Procedural variables.

	N=57	%
Type of lesion:		
Stenosis	44	77.1
Occlusion	14	24.5
Site of lesion:		
Axillary	11	22
Subclavian	10	20
Innominate vein	32	64
SVC	4	8

The symptoms of CVD varied from upper limb oedema, dilated arm and chest veins and vascular access thrombosis. 23 (46%) of cases presented with symptoms lasting more than 2 months.

Initial percutaneous angioplasty was technically successful in 34 (68%) of central veins lesions, however in the remaining 9 central vein lesions there was failure of wire passage. Stenting of the central vein lesions was done in 8 patients.

Table (4): Technical success of the procedure.

Technical success	N=57	%
Successful cases	34	68
Unsuccessful cases	16	32

Follow-up of a total of 34 successful cases after one year period revealed 24 cases were free of symptoms while 10 cases had recurrent symptoms. One year patency rate of cases with single lesion was 91.6%, and those with multiple lesions was 8.3% and that was statistically significant.

Table (5): Patency rates according to procedural variables.

	One-year follow-up				*p*-value
	Patent (n=24)		Recurrent (n=10)		
	No.	%	No.	%	
Site of the lesions:					
Axillary vein	5	20.8	1	10	0.3
Subclevian vein	5	20.8	1	10	
Innominate vein	13	54.1	6	60	
SVC	1	4.1	2	20	
Multiplicity of lesions:					
Single	22	91.6	5	50	0.06
Multiple	2	8.3	5	50	

One year patency rate for right sided AVFs was 16.6% and for left sided AVFs was 83.3% with statistically insignificant *p*-value. According to the type of AVFs, one year patency rate for native AVFs was 79.1% and for synthetic AVFs was 20.8% which was statistically insignificant.

Table (6): Patency rates according to AVF chracters.

	One-year follow-up				*p*-value
	Patent (n=24)		Recurrent (n=10)		
	No.	%	No.	%	
Type of AVF:					
Native	19	79.1	6	60	0.24
Synthetic	5	20.8	4	40	
Side:					
Right	4	16.6	7	70	0.02
Left	20	83.3	3	30	
Type of lesion:					
Stenosis	20	83.3	8	80	0.8
Occlusion	4	16.6	2	20	

The one year patency rate for stented cases was 25% and 75% for cases that PTVA alone and that was statistically insignificant.

Table (7): Patency rates of stented cases.

	One-year follow-up				*p*-value
	Patent (n=24)		Recurrent (n=10)		
	No.	%	No.	%	
Stenting:					
Yes	6	25	2	20	0.7
No	18	75	8	80	

Discussion

Central venous obstruction is one of the most common reasons for shunt dysfunction in chronic hemodialysis patients. In most cases, this problem occurs as a chronic complication of subclavian dialysis catheters used for temporary hemodialysis access. Endovascular techniques, including PTA, have gained popularity for the initial treatment of symptomatic CVOD [5].

The goal of the current prosepective study was to review our experience with PTA for symptomatic lesions and to determine the effectiveness of this approach for controlling symptoms and maintaining AVF patency.

We studied 50 patients with chronic renal failure with mean age (47.77 ± 10.49) having upper limb AVF presented with venous hypertension. Sixty percent of patients were females and 40% were males, in contrast to study done by Sprouse et al., [6], Shi et al., [7], Oguzkurt et al., [8] where most of their patients were males presented with these.

This was in line with Mukesh et al., [9], Young et al., [10] where most of their patients were females by percentages 63.6%, 54.4% respectively with a mean age of 55.1 years.

We found that 54% of our patients were hypertensive. This was concomitant with Surowiec et al., [11] who reported that 60% of their patients were hypertensive and 48% were diabetcs.

Keeping with Kambiz et al., [12] who found that (48%) of their patients were hypertensive, (45%) of patients were diabetecs, (45%) of patients had significant coronary artery disease.

We found that 64% of lesions were left sided while Mukesh et al., [9] found that 63.6% of lesions were at the right side. This can explain the shorter period from AVF creation till the appearance of symptoms in our study that was more than one year in 54% of cases with mean ± SD; 19.53 ± 16.39 months, and longer periods in Mukesh et al., [9] that was mean ± SD 2.5 years (range: 3 months-4.5 years).

Keeping with Young et al., [10] who found that 63.6% of the lesions were left sided, however the mean time interval between surgical creation of the autogenous fistula and subsequent central venous intervention in this group patients was 35 ± 12.4 months.

We found that 76% of the AVF were native, 24% were synthetic and this in contrast to Surowiec et al., [11] where 57% were synthetic.

In Dammers et al., [13], Oguzkurt et al., [8], Fotini et al., [14], and Kambiz et al., [12] found that the majority of AVF were native with percentage 54%, 84%, 80% and 90% respectively.

In our study 44% of the patients had brachiocephalic AVF, keeping with to Kambiz et al., [12] and Oguzkurt et al., [8] who found that most of patients had brachiocephalic AVF by 69.1% and 66% respectively.

In this study, 75% of patients had previously underwent ipsilateral central venous cathertrization mostly at jugular veins. The remaining 18% lesions were not associated with central venous cathertrization. In similarity to Dammers et al., [13], Oguzkurt et al., [8], Surowiec et al., [11] and Kalman et al., [15] who observed that 86%, 90%, 54% and 90% of their patients respectively had a history of previous central vein catheters.

In our experience the lesions were most commonly located in the innominate vein. It was involved in 64% of patients followed by the axillary vein in 22% of patients, the subclevian vein in

20%, and superior vena cava in 4 cases. This was in agreement with Shi et al., **[16]** and Mukesh et al., **[9]** who stated that most lesions were located at innominate vein by 91.6% and 72.7% respectively.

In contrary to Surowiec et al., **[11]**, Young, et al., **[10]** and Bakken et al., **[17]** who reported that most of their lesions were located at subclavian vein by 67.5%, 48,6%, 72.3 and 48% of their lesions respectively.

In our study, we found that 80% of lesions were stenosis and the remaining 20% were occlusive in nature, in concomitant with Young, et al., **[10]** and Aytekin et al., **[18]** who found that most lesions were stenosis by 79.2% and 78.5% respectively. However, Dammers et al., **[13]**, Shi et al., **[16]** and Mukesh, et al., **[9]** reported that central venous occlusion was seen in 60.7%, 58.3% and 61.1% respectively.

In our study, initial percutaneous angioplasty was technically successful in 68% of cases keeping with Surowiec et al., **[11]**, Shi et al., **[16]** and Mukesh et al., **[9]** who reported that technical success rate was 89%, 83.3% and 81.8% respectively.

In our study only 16% of lesions had primary stenting, in agreement with Sprouse II et al., **[6]** whose patients had stent placement by 19% and Shi et al., **[16]** who reported that 55% of cases had 1ry stenting. In contrary to Mukesh et al., **[9]** only PTA was done in two cases (22.22%) and seven cases (77.77%) had balloon angioplasty with stenting as Mukesh et al., **[9]** had total of 11 patients in which technical success was achieved in 81.8% cases (9/11) and in two patients, the occluded segment could not be negotiated giving total number of 9 patients in whom the procedure was successful.

In the current study, one year patency rate for stented cases was 25% and 75% for cases with PTVA alone and that was statistically insignificant, in similar to Fotini et al., **[14]** who stated that the 3, 6, 12 and 24-month primary patency rates were 88.3%, 65.3%, 45.6% and 25.5%, respectively.

In contrast to Shi et al., **[16]** where the primary patency rates were (48.6±18.7) % in the PTA group alone; (77.1±14.4) % at 1 year after treatment in the PTA with stent group. This high rates for stent group can be explained as Percutaneous Transluminal Angioplasty (PTA) was performed in nine cases and stent was performed in 11 cases while in our study number of stented case was 3 in 24 patients.

In our study, patency rates of collectively 34 patients are 100%, 97%, 70% at 3 , 6, 12 months respectively. In contrast to Shi et al., **[16]** who found that the primary patency rates of collectively 22 patients in whom 11 patients had stenting were (88.9±10.5) %, (64.8±10.5) % and (48.6±18.7) % at 3 months, 6 months and 1 year after treatment in the PTA group; (90.0±9.5) % and (77.1±14.4) % at 6 months and 1 year after treatment in the stent group, respectively.

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Conflicts of interest:

There are no conflicts of interest.

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دور الجراحة التداخلية فى علاج ضيق الآوردة المركزية لدى مرضى الفشل الكلوى

تعتبر الوصلة الشريانية الوريدية واحدة من مقومات الغسيل الكلوى الناجح، ولكن معرفة الطبيب والمريض بالمشاكل التى قد تحدث من الوصلة يظل العامل الآهم من مقومات الغسيل الناجح لمنع آى مخاطر قد تحدث للمريض والتى تتراوح من فقد الوصلة نفسها آو النزيف منها آو حتى الوفاة.

ويعتبر ضيق الآوردة المركزة لدى مرضى الفشل الكلوى من آكثر المضاعفات المترتبة عن إجراء الوصلة الشريانية للغسيل الكلوى وذلك على التوازى مع زيادة آعداد القساطر المركزية المؤقتة التى تستخدم كوسيلة مؤقتة للغسيل الكلوى لحين إستخدام الوصلة الشريانية.

ويعتبر من آهم آسباب إرتفاع ضغط الدم الوريدى تركيب القسطرة المؤقتة فى الوريد الوداجى آو تحت الترقوى على نفس الناحية من الوصلة الشريانية الوريدية، ومن آعراض المرض التورم الشديد والآلم بالطرف العلوى والغسيل الكلوى الغير كافى.

ونستعرض الطرق العلاجية لإرتفاع ضغط الدم الوريدى ومنها توسيع للوريد بإستخدام البالون آو التدخل الجراحى آو ربط الوصلة تماما والذى يعد الخيار الآخير فى حالة عدم الإستجابة للخيارات الآخرى. بالنسبة للعلاج بالتوسيع بإستخدام البالون فقد آثبت فعاليتة عن الطرق الجراحية.

ولكن من عيوب إستخدام التوسيع بالبالون للعلاج حدوث نزيف مكان إدخال السلك المرشد آو تحرك الدعامات من مكانها آو تمدد بالشريان فى مكان الدعامة. مثل هذه المشاكل لا تحدث بصورة دائمة. ويعتبر هذا التدخل آفضل من نظيرة الجراحى بسبب قصر فترة الإقامة بالمستشفى وسرعة الإفاقة من العملية والعودة آسرع لممارسة الحياة اليومية.

الهدف من الدراسة الحالية: تقييم مدى كفاءة الجراحة التداخلية لعلاج إرتفاع الضغط الوريدى فى مرضى الفشل الكلوى ذوى الوصلات الشريانية الوريدية فى الطرف العلوى.

آدرجت فى الرسالة ٥٠ حالة تعانى من ضيق بالآوردة المركزية من مرضى الفشل الكلوى ممن لديهم وصلات شريانية بالطرف العلوى تتراوح آعمارهم ما بين العشرين عاما وحتى السبعين عاما ترددت على قسم جراحة الآوعية الدموية والشرايين بمستشفى آسيوط الجامعى فى الفترة من مايو ٢٠١٥ وحتى مايو ٢٠١٦.

وقد آظهرت الدراسة ما يلى:

تعتبر القسطرة الوريدية المركزية من العوامل الآساسية المسببة لحدوث ضيق الآوردة المركزية حيث وجد آن ٢٥ مريض من المدرجين بالرسالة لديهم تاريخ مرضى من تركيب قساطر وريدية مركزية.

كانت آعلى نسبة من حدوث ضيق الوريد المركزى لصالح الوريد العضدى الراسى بنسبة ٦٤٪ يلية الوريد تحت الترقوى بنسبة ٢٠٪ ثم الوريد الإبطى بنسبة ٢٢٪.

الجراحة التداخلية بإستخدام البالون كانت ناجحة بنسبة ٦٨٪ من المرضى وتم تركيب دعامات مركزية فى ال ١٦٪ المتبقى من المرضى.

معدل نجاح الجراحة التداخلية على مدار سنة متابعة كان ٧٠٪ لدى المرضى الذين إستجابوا مبدئيا للإجراء فى صورة تحسن الآعراض الإكلنيكية و١١.١٪ لدى المرضى الذين لم يستجيبوا إستجابة كاملة للإجراء وتلك النسب ذات دلالة إحصائية.

وتوصى الدراسة ما يلى:

تعتبر الجراحة التداخلية من آساليب العلاج الناجحة لعلاج ضيق الآوردة المركزية بسبب قصر فترة الإقامة بالمستشفى وسرعة الإفاقة من العملية والعودة آسرع لممارسة الحياة اليومية.