Journal of American Science
Websites:
http://www.jofamericanscience.org
http://www.sciencepub.net
Emails:
editor@sciencepub.net
sciencepub@gmail.com
MARSLAND PRESS
Multidisciplinary Academic Journal Publisher

Vascular access complications and risk factors in hemodialysis patients in different age groups.

Dalia Glal Mohamed Abozeid[1]MSC, Fatma Abdelkader Attia[1]MD, Hend Gamal Kotb[1,]MD, Mohamed Abdelhameid Goma[2]MD.
[1] Internal Medicine Department, Faculty of Medicine (for Girls), Al-Azhar University, Cairo, Egypt
[2]Vascular surgery Department, Faculty of Medicine (for Boys), Al-Azhar University Cairo, Egypt
dr_doly2006@yahoo.com

Abstract: The VAs ought to be planned and programmed sufficiently in advance to be available at the start of the hemodialysis. The planning shouldn't only include the first VA, but also new ones in the medium and long term must be foreseen. It is important to have some flexibility on vascular access practice to accommodate patient specific needs and circumstances and facilitate patient involvement in clinical decision making. This study was conducted on 60 patients of different age groups aimed to demonstrate the most common dialysis access complications and risk factors for development of these complications. We also answered the question whether age is considered a poor prognostic risk factor for development of VA complications or not. Patients who started HD for more than one year were candidate for the study and were subjected to thorough full history taking, laboratory investigation including serum creatinine, blood urea, CBC, serum albumin, culture and sensitivity and measuring Kt/v, in addition to Doppler ultrasound examination to assess the access. While patients who were on peritoneal dialysis, had malignancy, undergone renal transplantation and also patients aged less than 20 years old were excluded from this study. Autologous AVFs are generally the first choice, recommending prosthetic VA when the possibilities of autologous AVF in Upper extremity have been exhausted. The CVCs should be of limited use and only indicated if there is acute renal failure, temporary HD and absence of maturation or impossibility or contraindication of another type of VA. And finally, the clinical characteristics of each patient may affect the indication of the technique to be performed. We found that most patients had started dialysis therapy using a temporary CVC despite its complications as bleeding, infection, arrhythmias and venous thrombosis, therefore, those patients should be referred to a nephrologist well in advance of the need for dialysis. Thrombosis, infection, Aneurysm and Stenosis are the most common complications of the vascular access. Staphylococcus infection is the commonest type of infection. Infected cases showed lower values of serum albumin and significant leukocytosis. The prevalence of these complications was independent on the age of the patients. Risk factors for dialysis related access complications include HTN, DM, IHD and smoking are the most common contributing risk factors. We found that IHD is higher in aged patients and can be considered a risk factor for VA malfunction especially in aged patients (65-80 years). Several previous reports failed to find any association between age and access complications, though others reported a significant effect of age. We found that patient age doesn't necessarily reflect his or her physiological status and not consider as a poor prognostic factor for the development of access related complications and that the technique survival of vascular access in these patients is similar to that in younger patients. Smoking history has been examined in few studies of vascular access morbidity, with inconsistent results. In this study, current or previous smoking was associated with a relative hazard for subsequent access events. Access complications require intervention to maintain adequate flow for effective hemodialysis. The most common forms of intervention for stenosis are percutaneous transluminal angioplasty and surgery. Interventions for thrombosis include percutaneous thrombolysis and surgical thrombectomy. Pseudoaneurysm and aneurysm required intervention depending on presence of infection, thinning of the skin and shorten area for cannulation. Creation o f a new access should be done if these therapies fail to restore adequate flow. Identification of risk factors related access complications, decrease the incidence of these complications and how to improve the vascular access outcome may result in significant savings and an improved quality of life for these patients.
[Dalia Glal Mohamed Abozeid, Fatma Abdelkader Attia, Hend Gamal Kotb, Mohamed Abdelhameid Goma. **Vascular access complications and risk factors in hemodialysis patients in different age groups.** *J Am Sci* 2020;16(12):51-62]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). http://www.jofamericanscience.org. 4. doi:10.7537/marsjas161220.04.

Key words: AV fistula, AV shunt, End stage renal disease, Angioplasty, Catheter related complications.

1. Introduction

The hemodialysis vascular access is the lifeline for end stage renal disease patients. Vascular access malfunction places substantial clinical, social and economic burden on hemodialysis population **(Chen et al., 2019)**.

There currently are three main forms of hemodialysis vascular access: (1) The native arteriovenous fistula (AVF), (2) the polytetrafluoroethylene (PTFE) graft, and (3) the cuffed double lumen silicone catheter. Each of these forms of hemodialysis vascular access has its own specific problems **(Roy-Chaudhury et al., 2006)**

Arteriovenous fistulae (AVF) have the lowest rates of access-related events and longer survival, when compared with Arteriovenous grafts or central venous catheters, and therefore are the preferred vascular access modality. However, AVF associated complications remain one of the most important causes of morbidity and health care expenditure in hemodialysis patients **(Moreira et al., 2019)**.

An arteriovenous fistula is created by surgically creating an anastomosis between an artery and a vein. Following the creation of this anastomosis, the vein undergoes maturation and is subsequently used for dialysis therapy. In contrast, an arteriovenous graft is created by anastomosing a polytetrafluoroethylene (PTFE) tube to the side of an artery and the end of a vein. In patients with an arteriovenous graft, the PTFE material serves for needle insertion for dialysis **(Masud et al., 2018)**.

The most important complications of fistulae for hemodialysis are lymphedema, infection, aneurysm, stenosis, congestive heart failure, steal syndrome, ischemic neuropathy and thrombosis. In hemodialysis patients, the most common cause of vascular access failure is neointimal hyperplasia. It is important to gain information about early clinical symptoms of arteriovenous fistula dysfunction in order to prevent and adequately treat potential complications **(Stolic, 2012)**.

Extensive morbidity related to hemodialysis vascular access has been reported. According to many studies, women, blacks, diabetics and elderly people appear to be at particularly high risk. The reports vary considerably on age as a risk factor of the success of permanent vascular access **(Grapsa et al., 1998)**

Ballard et al. report that those older than 60 who had a major angio-access complication had a significantly higher mortality rate than those younger than 60 **(Mousa and Ballard, 2017)**

The major threat to the arteriovenous fistula is vascular lesions due to hypertensive vascular disease, or diabetes **(Mousa and Ballard, 2017).** Despite these risks, the success rate for vascular access for chronic hemodialysis in the elderly is similar to younger patients according toreports of several authors **(Lazarides et al., 2007)**.

Because of these differences among published reports about the success of vascular access in the elderly and complication; we reviewed a retrospective and analytic study with 60 patients on maintenance hemodialysis aged 20-80 years.

Aim of the Work

This study had designed to focus on and to report vascular access complications and dysfunction in 60 chronic hemodialysis patients aged 20-80 years.

2. Subject and Methods

Subjects:

This is a prospective study conducted on 60 patients who are on regular hemodialysis recruited from nephrology and vascular surgery unit in New Kasr AlAiny Teaching Hospital over 11 months after approval by the Research Ethical Committee of Faculty of Medicine for Girls, Al-Azhar University (a consent was taken from all subjects for ethical consideration). the patients were divided into two groups A and B.

60 patients with ESRD on regular hemodialysis were recruited for the study they are on Regular hemodialysis 3 times/week with (hours duration for each dialysis session), 44 of them were males and 16 of them were females. Their ages ranged from 20 to 80 years with mean +- SD of 48.03±9.37 and 71.36±3.62 respectively between group A and group B.

Inclusion Criteria:-

All patient who started HD for more than one year and had vascular access complications are candidate for the study. Sixty patients, aged [20 – 80] years who were on hemodialysis for one year at least and had undergone vascular access procedures. Cimmino Brescia fistula, PTFE (synthetic polytetrafluoroethylene) grafts were included in the study. The patients were divided according to their age into 2 groups [A & B].

- **Group A:** includes 30 patients who were younger than 65 years [20-65] at onset of hemodialysis modality as a renal replacement therapy.
- **Group B:** includes 30 patients who were older than 65 years [65-80] at onset of hemodialysis modality as a renal replacement therapy.

Exclusion Criteria:

All patient on HD were Candidate for the study except for

- Patients age < 20 years.
- Patients who recently placed their first VA shunt.
- Pregnant women.
- Patients who previously were on peritoneal dialysis.
- Patients had undergone renal transplantation.

- Patients with malignancy.
- Patients with coagulation disorders .
- Patients with autoimmune disease.
- patients who had significant neurovascular events as stroke or major intervention.
- Patients with poor adherence to required dialysis protocol.
- Patients who currently participating in another investigational drug or device study which may interfere with the end points of the study.
- Critically ill patients who admitted to intensive care units.

Methods:

All subjects of the study were subjected to the following:

A. Thorough full history taking and clinical examination: All patients underwent detailed history taking, and data were collected on age, sex, and cardiovascular risk factors such as diabetes mellitus (DM) and hypertension. In addition, history of previous access and any complications that developed since the use of that access were ascertained.

B. Laboratory investigation with include:

- Renal function tests including: serum creatinine, Blood urea.
- iPTH.
- eGFR: calculated by the abbreviated MDRD equation: 186 x $(Creatinine/88.4)^{-1.154}$ x $(Age)^{-0.203}$ x (0.742 if female) x (1.210 if black).
- CBC: Complete blood picture.
- Serum albumin.
- Fasting blood sugar.
- Kt/v measured by QXMD calculate app.
- _ Culture swab from the skin of the vascular access.
- _ Blood culture.

Statistical analysis

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) **(Statistical Package for the Social Sciences)** software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD, the following tests were used to test differences for significance;. difference and association of qualitative variable by Chi square test (X^2). Differences between quantitative independent groups by t test, correlation by Pearson's correlation. P value was set at <0.05 for significant results & <0.001 for high significant result

3. Results

The result of the present work are presented in the following tables:

Age was distributed as 48.03±9.37 and 71.37±3.62 respectively between group A and group B. Group B was significantly older, but BMI was significantly lower among group B and regard sex distribution male were majority in both group with no significant difference between them. eGFR was significantly lower among group B (P value = 0.013).

Table 1: Age, BMI and sex distribution between studied groups.

			Group A	Group B	t/ X^2	P
Age			**48.03±9.37**	**71.37±3.62**	**-12.72**	**0.00****
BMI			**27.54±2.26**	**25.98±1.39**	**2.592**	**0.012***
eGRF			**16.21±6.45**	**12.47±5.05**	**2.66**	**0.013***
Sex	**Male**	**N**	**23**	**21**	**0.58**	**.567**
		%	**76.7%**	**70.0%**		
	Female	**N**	**7**	**9**	**-0.58**	**0.567**
		%	**23.3%**	**30.0%**		
Total		**N**	**30**	**30**		
		%	**100.0%**	**100.0%**		

Table (2) shows that HTN, DM, IHD and smoking are the most common contributing risk factors for VA malfunction with subtle differences between two groups except for IHD whose incidence was higher in group B (33.3 %) in comparison with group A which was (16.67 %).

Table (3) shows the most common complications occurred to our patients and their percentages in both groups.

To be noted: although the total number of patients included in this study is 30 patients for each group according to their age, we have found that there is a significant VA complications overlapping among those patients; usually each patient will manifest more than one complication a time for example (the patient may show both thrombosis and infection, so this patient will be counted twice), summing up the final total number for the complication groups to be more than the actual number of the patients in this study. Hence, this number doesn't refer to the patients themselves but the frequency of each complication per se among patients.

Table 2: Risk factors and co-morbidities distribution between studied groups

			Group		Total	X^2	P
			Group A	**Group B**			
HTN	**-VE**	**N**	**9**	**6**	**15**		
		%	**30.0%**	**20.0%**	**25.0%**		
	+VE	**N**	**21**	**24**	**45**	**0.89**	**0.38**
		%	**70.0%**	**80.0%**	**75.0%**		
DM	**-VE**	**N**	**19**	**18**	**37**		
		%	**63.3%**	**60.0%**	**61.7%**		
	+VE	**N**	**11**	**12**	**23**	**0.26**	**0.795**
		%	**36.7%**	**40.0%**	**38.3%**		
IHD	**-VE**	**N**	**25**	**20**	**45**		
		%	**83.3%**	**66.7%**	**75.0%**		
	+VE	**N**	**5**	**10**	**15**	**1.49**	**0.141**
		%	**16.67%**	**33.3%**	**25.0%**		
Smoking	**-VE**	**N**	**25**	**24**	**49**		
		%	**83.3%**	**80.0%**	**81.7%**		
	+VE	**N**	**5**	**6**	**11**	**0.33**	**0.744**
		%	**16.7%**	**20.0%**	**18.3%**		
Total		**N**	**30**	**30**	**60**		
		%	**100.0%**	**100.0%**	**100.0%**		

Table 3: Comparison between the prevalence of the most common complications of VA between the 2 studied groups in correlation to age

Complication / Age	Thrombosis		Stenosis		Aneurysm		Pseudoaneurysm		Infection		DASS	
	Number (frequency %)	Mean ± SD	Number (frequency %)	Mean ± SD	Number (frequency %)	Mean ± SD	Number (frequency %)	Mean ± SD	Number (frequency %)	Mean ± SD	Number (frequency %)	Mean ± SD
Patients < 65 years old, (total number=30)	11 (36.66%)	0.3 ± 0.466	7 (23.33%)	0.233 ± 0.430	8 (26.66%)	0.367 ± 0.490	1 (3.33%)	0.033 ± 0.1825	10 (33.33%)	0.300 ± 0.466	0 (0%)	0 ± 0
Patients > 65 years old, (total number=30)	12 (40%)	0.4 ± 0.498	4 (13.33%)	0.133 ±0.345	10 (33.33%)	0.366± 0.490	1 (3.33%)	0.033 ± 0.1825	11 (36.66%)	0.233 ± 0.430	1 (3.33%)	0.033 ± 0.1825
P value **(NS= non significant)**	**0.425 (NS)**		**0.325 (NS)**		**>0.999 (NS)**		**>0.999 (NS)**		**0.567 (NS)**		**0.338 (NS)**	

Table 4: Different types of permanent vascular access commonly used for hemodialysis in ESRD patients.

	AVF	AVG	permanent catheter
	Number (frequency %)	Number (frequency %)	Number (frequency %)
Patients < 65 years old, (total number=30)	27 (90%)	2 (6.66%)	1 (3.33%)
Patients > 65 years old, (total number=30)	28 (93%)	0 (0.00%)	2 (6.66%)

The table shows that **AVF** is, by far, the most preferred vascular access to be used for hemodialysis in ESRD patients regardless to their age.

Table 5: Showed the frequency and type of organisms diagnosed by blood culture of the studied groups (total number of the patients 60).

blood culture		**Positive**				**Negative**
Organism		Staph	Pseudomonas	Klebsiella Pneumoniae	Fungus	
Number of Patients	Group A	1	0	0	0	29
	Group B	1	2	0	0	27

This table shows that most of our patients are free of infections and blood culture was positive only in 1 and 3 patients in group A and group B respectively. Staphylococcus infection was the commonest type in group A while pseudomonas infection was the commonest in group B.

Table 6: Blood culture from patients were analyzed to detect the presence f pathogens (+ve) or pathogen-fee (-ve) and compared in correlation to patients' ages.

Blood culture Age	+ve		-ve	
	Number (frequency %)	**Mean ± SD**	**Number (frequency %)**	**Mean ± SD**
Patients<65 years old, (total number=30)	1 (3.33%)	0.033 ± 0.183	29 (96.66%)	0.967 ± 0.183
Patients > 65 years old, (total number=30)	3 (10%)	0.1 ± 0.305	27 (90%)	0.9 ± 0.305
P value *(NS= non significant)*	**0.310 *(NS)***			

This table shows that most of our patients are free of systemic infections (56 patients of total number 60 patients) and the blood culture was positive in 4 patients (1 patient in group A and 3 patients in group B).

Table 7: Showed the frequency of infection detected by culture swab among the studied groups (total number of patients: 60 patients)

Culture swap		**Positive**				**Negative**
Organism		Staph	pseudomonas	Klebsiella Pneumoniae	Fungus	
Number of Patients	Group A	7	2	0	0	21
	Group B	3	3	2	0	22

This table shows the culture swab was negative in 21, 22 patients in gr A and gr B respectively. Staphylococcus infection was the commonest type of infections.

Table 8: lab parameters distribution between studied groups

	Group A	Group B	t	P
S Cr	**2.14±0.63**	**2.27±0.87**	**0.641**	**0.524**
Bl urea	**60.86±18.23**	**61.31±15.4**	**0.121**	**0.911**
IPTH	**412.8±251.7**	**396.9±249.5**	**0.25**	**0.802**
S albumin	**3.76±0.35**	**3.57±0.41**	**1.872**	**0.066**
RBS	**119.56±26.17**	**107.53±19.37**	**2.024**	**0.048***
HB	**9.89±1.26**	**9.60±1.11**	**0.935**	**0.354**

There was no significant difference except at RBS as group A was significantly higher than group B.

Table 9: Correlation between patient's age with other parameters

		Age
S Cr	**r**	**0.072**
	P	**0.582**
Bl urea	**r**	**-0.173**
	P	**0.185**
BMI	**r**	**-0.116**
	P	**0.379**
KT/ V	**r**	**-0.308***
	P	**0.017**
S albumin	**r**	**-0.154**
	P	**0.241**
RBS	**r**	**-0.176**
	P	**0.179**
HB	**r**	**-0.078**
	P	**0.553**
WBCs	**r**	**0.045**
	P	**0.730**
PLT	**r**	**-0.147**
	P	**0.262**

This table shows that, There was significant negative correlation between KT/ V and age (r = -0.308).

Table 10: Relation between infection, Serum albumin and total leucocytic count

	Infected	Not	t	P
S albumin	**3.42±0.49**	**3.76±0.31**	**3.143**	**0.003***
WBCs	**14735±3915**	**6234±2018**	**11.13**	**>0.001***

Serum albumin was significantly lower among infected cases, while WBCS were significantly higher (leukocytosis). P value ≤ 0.05 is considered to be statistically significant.

Table 11: Relation between DM and infection

			DM		X^2	P
			Not	DM		
Systemic infection	-VE	N	36	20		
		%	97.3%	87.0%		
	+VE	N	1	3	2.43	0.118
		%	2.7%	13.0%		
Local infection	-VE	N	30	13		
		%	81.1%	56.5%		
	+VE	N	7	10	4.21	0.04*
		%	18.9%	43.5%		
Total		N	37	23		
		%	100.0%	100.0%		

Local infection was significantly associated with DM.

Table 12: Management of thrombosed arteriovenous fistulas

Modality of reatment	Group A frequency		Group B frequency	
	N	%	N	%
Surgical thrombectomy	3	27.3	4	33.3
Access ligation	8	72.7	8	66.7
Total	11	100	12	100

8 patients (72.7) in group A and 8 patients (66.7) in group B with thrombosed access didn't undergo a trial of thrombectomy as a result of either late presentation. or thrombus propagation. New accesses were created in these cases. On the other hand, 3 patients in group A and 4 patients in group B with thrombosed access underwent surgical thrombectomy.

Table 13: Management of pseudoaneurysms

Modality of treatment	Group A frequency		Group B frequency	
	N	%	N	%
Repair of the access	1	100	0	0
No intervention	0	0	1	100
Total	1	100	1	100

Pseudoaneurysm was the presenting complication in only one patient in group A and group B. The patient with pseudoaneurysm in gr A was treated successfully by repairing the underlying site of puncture by simple suturing while the patient in group B need no intervention but observation and follow up.

Table 14: Management of access stenosis

Modality of treatment	Group A frequency		Group B frequency	
	N	%	N	%
Balloon angioplasty	5	71.4	2	50
Access ligation	2	28.6	2	50
Total	7	100	4	100

Of 60 patients, 11 patients presented with access stenosis. Balloon angioplasty was successfully performed in 5 patients in group A and 2 patients in group B. venoplasty failed in 2 patients in gr A and 2 patients in group B, ligation of the fistula was done.

Table 15: Management of aneurysm

Modality of treatment	Group A frequency		Group B frequency	
	N	%	N	%
aneurysmorrhaphy	6	27.3	7	33.3
Access ligation	2	72.7	3	66.7
Total	8	100	10	100

This table shows that 8 patients in group A and 10 patients in group B presented with aneurysm. Aneurysmorrhaphy was performed successfully in 6 and 7 patients in group A and B respectively, whereas ligation of the access was performed in 2 patients in group A and 3 patients in group B with diffuse aneurysmal venous outflow tract.

4. Discussion

Late phase kidney failure has been defined as a chronic disease which results from accumulation of metabolic effluents in the body. Chronic renal failure affects the entire body and untreated renal failure can be life-threatening. Renal replacement treatment (RRT) with hemodialysis or peritoneal dialysis is considered the second choice when the patient can't undergo kidney transplantation **(Kaygın, 2020)**.

Many patients, who are not candidates for renal transplantation or those for whom a compatible donor can't be secured, are dependent on HD for their lifetime. This situation results in the long- term need and usage of dialysis access. There are a lot of short and long- term complications that may interfere with the functioning of the dialysis. In addition, patients with chronic renal failure have a higher mortality rate, mostly due to cardiovascular and infectious complications. Part of this high mortality rate is due to haemodialysis vascular access–related complications **(Aljuaid et al., 2020)**.

The first choice of vascular access recommended by the KDOQI is arteriovenous fistula (AVF). That is because of its lower rates of infection and prolonged survival rate compared to arteriovenous grafts (AVG) and tunneled catheters. However, vascular access still doesn't come without problems. It was reported that only a minority (26%) of created fistulas become mature at 6 months and 21% were left without being able to be used. Moreover, the patency rate of primary unassisted fistulas at 6 months was only 64% **(Chen et al., 2019)**.

In general, evidence on the association of age and AVF outcomes is scarce in the literature and definition of "elderly" is often inconsistent and hence the results of AVF outcomes are conflicting **(Qian et al., 2020)**.

Therefore, and based on our medical observations and the wide variations in age among renal patients, here, through this study, we aim to investigate the most common events that are known to alter a successful life-time course of hemodialysis, using the age of the patient as a fundamental scale to determine the severity of comorbid outcomes associated with each event.

The current study was conducted on 60 dialysis patients divided into two groups according to their age; group A: included 30 patients who were younger than 65 years old when they have started dialysis [20-65 years old] and group B: included 30 patients who were older than 65 years old when they started hemodialysis [65-80 years old].

First, we compared the timing and the type of vascular access in each group to rule out the possibility that the type of fistula can alter our final conclusion. According to shah et al. 2018, about 80% of American patients initiate hemodialysis using CVC, although arteriovenous access confers survival benefits over CVC in hemodialysis patients. The same attitude among Egyptian patients was also observed in our study, in which 73.33% and 90% of our patients in group A and group B respectively initiated hemodialysis therapy using CVC. Despite the strong recommendations to reduce central venous catheters as HD access for prevalent dialysis patients, the use of CVCs remains widespread among HD patients. Our study demonstrated that, regardless of age, Cimmino Brescia fistula is the preferred access to maintain dialysis therapy in both groups by 90% and 93% in group A and group B respectively. This gets in harmony with **(Waerme et al., 2020)** who reported in his observational study that included 153 chronic HD patients that radio-cephalic (RC) fistula was used in 90% of his cases. On the other hand, it was reported by **(Aljuaid et al., 2020)** that when the relationship of type of AVFs with age of the patients were assessed, there was no possible association observed.

The adequacy of HD can be assessed and measured by Kt/V. This represents the product of clearance (K) per time multiplied by the duration (t) and adjusted for body size by dividing this clearance by the distribution volume (V). It is well-documented that elders undergo unstoppable physiological as well as pathological changes such as less metabolic rates and less body mass. Such changes alter the rate of uremic accumulation in their body, their tolerance to uremic accumulation and consequently the adequacy of their dialysis sessions. Therefore, there is an

upcoming call for individualized kt/v value especially in elder patients **(Kh et al., 2017, Bossola et al., 2005).** Indeed, our study supports such call by reporting a significant negative correlation between Kt/V and age. Previous study conducted by **(Moist et al., 2006)** has also highlighted age, body mass index, and hemodialysis duration as important determinants for the primary success of the AVF.

Along with the age, the adequacy of AVF is dependent on many other, and equally important, risk factors that can lead to increased morbidity and mortality rate in HD patients. In **(Monroy-Cuadros et al., 2010)** study, history of diabetes, and smoking were presented as independent risk factors for fistula failure after 6 months of first usage. Also **(Aljuaid et al., 2020)** had reported in his study that HTN and DM are two major risk factors related to access complications.

Based on the above mentioned medical data, we aimed to study the significant association (if any) of HTN, DM, IHD, and smoking as the most common contributing risk factors leading to VA malfunction. In terms of HTN, DM, and smoking, we have noticed a subtle difference between the two age groups. HTN was the most common presenting risk factors for access failure as it occurred in 70% of our patients group A and in 80% of our patients in group B. D.M was the second most common risk factor occurred in 36.67% and 40% of our patients in group A and B respectively. However, the incidence of IHD was much higher in group B (33.3%) compared to group A (16.67 %) indicating that IHD can be considered a risk factor for VA malfunction especially in aged patients (65-80 years).

Over the past decades, creation and maintenance of VA has become challenging due to an increase in cardiovascular co-morbidities in the ESRD patient population. These conditions have impact on the quality of vessels involved in VA creation which makes the patient population more susceptible to post-operative complications, both on the short- and long term. **(Cruz et al., 2015)** had recorded in his retrospective study that diabetic HD patients had lower mean time before occlusion of arteriovenous fistulas) and a lower mean rate survival of vascular access to 24 months.

(Abdosh et al., 2020) stated that AVF complicated with thrombosis was the leading cause of AVF failure, followed by infection, stenosis, and arterial steal syndrome. In the current study, thrombosis was, as well, the most common presenting complications encountered in both groups by 36.66% in group A and by 40% in group B. Thrombosed dialysis fistula was managed by surgical thrombectomy in 3 patients (out of 11) and 4 patients (out of 12) in group A and group B respectively, while the rest of the patients underwent access ligation and new access formation due to late presentation or thrombus propagation. Surgical thrombectomy and restoration of access patency were also done for treating a thrombosed dialysis fistula by **(Palmer et al., 2006)** in majority of patients who were involved in his study. Another Vascular access–related complications to be outlined here was formation of stenosis. Out of the 60 patients included in our study, 11 patients presented with access stenosis which was successfully mitigated by Balloon angioplasty in 5 patients in group A and 2 patients in group B. In patients with failed Venoplasty (2 patients in each group), ligation of the fistula was done.

Followed by thrombosis, infection was the most common presenting complication to be associated with higher rate of AVF failure. The results of our study were consistent with previous studies **(Ghonemy et al., 2019, Astor et al., 2005).** It is to be noted, most of these studies were conducted independent on the age of the patients. Many authors have reviewed the pathogenesis of infection in dialysis population **(Lafrance et al., 2008).** Impaired host immunity, HD procedure itself, access type, and poor personal hygiene are mostly the causing factors in HD being complicated with infection, both local and systemic**(Thorarinsdottir et al., 2020).** In the current study, staphylococcus infection was the most common type of infection in both groups according to swab culture and sensitivity by (23.33%) in group A and (10%) in group B, followed by pseudomonas infection which occurred in 6.66% and 10% in group A and group B respectively. Infection by staphylococcus was previously documented by **(Ghonemy et al., 2019)** who reported that 47.8% of the patients suffered S. aureus while 4.2% suffered infection with pseudomonas. A study made by**(Scheuch et al., 2019)** found that the rate of staphylococcus nasal carriage was 51% among hemodialysis patients, which was considered a risk factor for these patients to develop S. aureus bacteremia.

Other studies such as **(Derakhshanfar et al., 2009)** reported that aneurysm was the most frequent occurred complications by 51% while infection and thrombosis were presented in only 3.3% and 4.4% of the patients, respectively. In the current study, aneurysmal dilatation over the venous outflow tract was the presenting complication in 26.66% of patients in group A and 33.33% of patients in group B. For fistula salvage, aneurysmorrhaphy has been reported in many studies such as **(Hastaoğlu et al., 2014, Berard et al., 2010)** to be a safe and satisfactory technique which should be adopted widely. In the light of these studies, aneurysmorrhaphy had been done successfully, in our study, for 6 and 7 patients in group A and B, respectively. Ligation was performed in patients who were not suitable for these repair

techniques. Pseudoaneurysm was the presenting complication in only 3.33% oF patients in each group. The patient with pseudoaneurysm in group A was treated successfully by repairing the underlying site of puncture by simple suturing while the patient in group B needed no intervention but observation and follow up. Also only one patient in group B through our study was presented with DASS and access ligation was done with new fistula formation.

Collectively, our results confirm that although age is an objective factor that can be used in choosing decisions, the elderly are a heterogonous group and an individual's chronological age does not necessarily reflect his or her physiological status.

References

1. ABDOSH, K., SULIMAN, I. & AHMED, G. 2020. Complications of Permanent Vascular Access in Hemodialysis Patients. *Journal of The Egyptian Society of Nephrology and Transplantation*, 20**,** 157-164.
2. ALJUAID, M., ALZAHRANI, N., ALSHEHRI, A., ALKHALDI, L., ALOSAIMI, F., ALJUAID, N., ASIRI, O. & ATALLA, A. 2020. Complications of Arteriovenous Fistula in Dialysis Patients: Incidence and Risk Factors in Taif City, Ksa. *Journal of Family Medicine and Primary Care*, 9**,** 407-411.
3. ASTOR, B. C., EUSTACE, J. A., POWE, N. R., KLAG, M. J., FINK, N. E. & CORESH, J. 2005. Type of Vascular Access and Survival among Incident Hemodialysis Patients: The Choices for Healthy Outcomes in Caring for Esrd (Choice) Study. *Journal of the American Society of Nephrology*, 16**,** 1449.
4. BERARD, X., BRIZZI, V., MAYEUX, S., SASSOUST, G., BISCAY, D., DUCASSE, E., BORDENAVE, L., CORPATAUX, J. M. & MIDY, D. 2010. Salvage Treatment for Venous Aneurysm Complicating Vascular Access Arteriovenous Fistula: Use of an Exoprosthesis to Reinforce the Vein after Aneurysmorrhaphy. *Eur J Vasc Endovasc Surg*, 40**,** 100-6.
5. BOSSOLA, M., MUSCARITOLI, M., TAZZA, L., PANOCCHIA, N., LIBERATORI, M., GIUNGI, S., TORTORELLI, A., ROSSI FANELLI, F. & LUCIANI, G. 2005. Variables Associated with Reduced Dietary Intake in Hemodialysis Patients. *J Ren Nutr*, 15**,** 244-52.
6. CHANG, T. I., PAIK, J., GREENE, T., DESAI, M., BECH, F., CHEUNG, A. K. & CHERTOW, G. M. 2011. Intradialytic Hypotension and Vascular Access Thrombosis. *Journal of the American Society of Nephrology: JASN*, 22**,** 1526-1533.
7. CHEN, B., WANG, P., BREM, A., DWORKIN, L., LIU, Z. & GONG, R. 2019. Mineralocorticoid Receptor: A Hidden Culprit for Hemodialysis Vascular Access Dysfunction. *EBioMedicine*, 39**,** 621-627.
8. CHESTERTON, L., LINDSEY, B. & FLUCK, R. J. 2014. Vascular Access: Improving Outcomes for Haemodialysis Patients. *Practical Nephrology*. London.: Springer, London.
9. CRUZ, R. N. d., RETZLAFF, G., GOMES, R. Z. & RECHE, P. M. 2015. Influência Do Diabetes Mellitus Sobre a Perviedade Da Fístula Arteriovenosa Para Hemodiálise. *Jornal Vascular Brasileiro*, 14**,** 217-223.
10. DERAKHSHANFAR, A., GHOLYAF, M., NIAYESH, A. & BAHIRAII, S. 2009. Assessment of Frequency of Complications of Arterio Venous Fistula in Patients on Dialysis: A Two-Year Single Center Study from Iran. *Saudi Journal of Kidney Diseases and Transplantation*, 20**,** 872-875.
11. GHONEMY, T. A., FARAG, S. E., SOLIMAN, S. A., AMIN, E. M. & ZIDAN, A. A. 2019. Vascular Access Complications and Risk Factors in Hemodialysis Patients: A Single Center Study. *Alexandria Journal of Medicine*, 52**,** 67-71.
12. GRAPSA, E. J., PARASKEVOPOULOS, A. P., MOUTAFIS, S. P., VOURLIOTOU, A. J., PAPADOYANNAKIS, N. J., DIGENIS, G. E. & ZEREFOS, N. J. 1998. Complications of Vascular Access in Hemodialysis (Hd) – Aged Vs Adult Patients. *Geriatric Nephrology and Urology*, 8**,** 21-24.
13. HADDAD, N. J., CLEEF, S. V. & AGARWAL, A. K. 2012. Central Venous Catheters in Dialysis: The Good, the Bad and the Ugly. *The Open Urology & Nephrology Journal, 2012*.
14. HASTAOĞLU, İ. O., HAMDI TOKÖZ & BILGEN, F. 2014. Aneurysmorrhaphy and Plication in the Revisions of Arteriovenous Fistula Aneurysm: Our Clinical Experience. *Turkish Journal of Thoracic and Cardiovascular Surgery*, 22**,** 71-75.
15. KAYGıN, M. A. 2020. Our Experiences with Hemodialysis Arteriovenous Fistula Aneurysm. *Turkish Journal of Vascular Surgery*, 29**,** 121-126.
16. KH, Y., D. M., M. M. & S, F. 2017. Dialysis Adequacy of Chronic Hemodialysis Patients in Zanjan-Iran, 2016. *Preventive Care in Nursing & Midwifery Journal*.
17. LAFRANCE, J. P., RAHME, E., LELORIER, J. & IQBAL, S. 2008. Vascular Access-Related Infections: Definitions, Incidence Rates, and Risk Factors. *Am J Kidney Dis*, 52**,** 982-93.

18. LAZARIDES, M. K., GEORGIADIS, G. S., ANTONIOU, G. A. & STARAMOS, D. N. 2007. A Meta-Analysis of Dialysis Access Outcome in Elderly Patients. *Journal of Vascular Surgery*, 45**,** 420-426.e2.
19. MASUD, A., COSTANZO, E. J., ZUCKERMAN, R. & ASIF, A. 2018. The Complications of Vascular Access in Hemodialysis. *Semin Thromb Hemost*, 44**,** 57-59.
20. MOIST, L. M., HEMMELGARN, B. R. & LOK, C. E. 2006. Relationship between Blood Flow in Central Venous Catheters and Hemodialysis Adequacy. *Clin J Am Soc Nephrol*, 1**,** 965-71.
21. MONROY-CUADROS, M., YILMAZ, S., SALAZAR-BAÑUELOS, A. & DOIG, C. 2010. Risk Factors Associated with Patency Loss of Hemodialysis Vascular Access within 6 Months. *Clinical journal of the American Society of Nephrology: CJASN*, 5**,** 1787-1792.
22. MOREIRA, C. L., CASTRO, A., SILVA, F., ALMEIDA, P., DE MATOS, A. N., SOUSA, C. N., ALMEIDA, R., CABRITA, A. & QUEIRÓS, J. A. 2019. Stenosis and Thrombosis-Unveiled Complications of Buttonhole Cannulation. *Hemodialysis International*, 23**,** E90-E92.
23. MOUSA, A. & BALLARD, J. 2017. Transcutaneous Oxygen Tension: Principles and Applications.
24. QIAN, J. Z., MCADAMS-DEMARCO, M., NG, D. K. & LAU, B. 2020. Arteriovenous Fistula Placement, Maturation, and Patency Loss in Older Patients Initiating Hemodialysis. *Am J Kidney Dis*.
25. ROY-CHAUDHURY, P., SUKHATME, V. P. & CHEUNG, A. K. 2006. Hemodialysis Vascular Access Dysfunction: A Cellular and Molecular Viewpoint. *J Am Soc Nephrol*, 17**,** 1112-27.
26. SCHEUCH, M., FREIIN VON RHEINBABEN, S., KABISCH, A., ENGEßER, J., AHRENDT, S., DABERS, T., KOHLER, C., HOLTFRETER, S., BRÖKER, B. M. & STRACKE, S. 2019. Staphylococcus Aureus Colonization in Hemodialysis Patients: A Prospective 25 Months Observational Study. *BMC Nephrology*, 20**,** 153.
27. STOLIC, R. 2012. Most Important Chronic Complications of Arteriovenous Fistulas for Hemodialysis. *Medical principles and practice: international journal of the Kuwait University, Health Science Centre*, 22.
28. THABET, B. E.-H., EWAS, M., HASSAN, H. & KAMEL, M. 2017. Complications of Arteriovenous Fistula in Dialysis Patients at Assiut University Hospital. *Journal of Current Medical Research and Practice*, 2.
29. THORARINSDOTTIR, H. R., ROCKHOLT, M., KLARIN, B., BROMAN, M., FRAENKEL, C. J. & KANDER, T. 2020. Catheter-Related Infections: A Scandinavian Observational Study on the Impact of a Simple Hygiene Insertion Bundle. *Acta Anaesthesiol Scand*, 64**,** 224-231.
30. WAERME, A. V. B., HADIMERI, H., NASIC, S. & STEGMAYR, B. 2020.
31. ABDOSH, K., SULIMAN, I. & AHMED, G. 2020. Complications of Permanent Vascular Access in Hemodialysis Patients. *Journal of The Egyptian Society of Nephrology and Transplantation*, 20**,** 157-164.
32. ALJUAID, M., ALZAHRANI, N., ALSHEHRI, A., ALKHALDI, L., ALOSAIMI, F., ALJUAID, N., ASIRI, O. & ATALLA, A. 2020. Complications of Arteriovenous Fistula in Dialysis Patients: Incidence and Risk Factors in Taif City, Ksa. *Journal of Family Medicine and Primary Care*, 9**,** 407-411.
33. ASTOR, B. C., EUSTACE, J. A., POWE, N. R., KLAG, M. J., FINK, N. E. & CORESH, J. 2005. Type of Vascular Access and Survival among Incident Hemodialysis Patients: The Choices for Healthy Outcomes in Caring for Esrd (Choice) Study. *Journal of the American Society of Nephrology*, 16**,** 1449.
34. BERARD, X., BRIZZI, V., MAYEUX, S., SASSOUST, G., BISCAY, D., DUCASSE, E., BORDENAVE, L., CORPATAUX, J. M. & MIDY, D. 2010. Salvage Treatment for Venous Aneurysm Complicating Vascular Access Arteriovenous Fistula: Use of an Exoprosthesis to Reinforce the Vein after Aneurysmorrhaphy. *Eur J Vasc Endovasc Surg*, 40**,** 100-6.
35. BOSSOLA, M., MUSCARITOLI, M., TAZZA, L., PANOCCHIA, N., LIBERATORI, M., GIUNGI, S., TORTORELLI, A., ROSSI FANELLI, F. & LUCIANI, G. 2005. Variables Associated with Reduced Dietary Intake in Hemodialysis Patients. *J Ren Nutr*, 15**,** 244-52.
36. CHANG, T. I., PAIK, J., GREENE, T., DESAI, M., BECH, F., CHEUNG, A. K. & CHERTOW, G. M. 2011. Intradialytic Hypotension and Vascular Access Thrombosis. *Journal of the American Society of Nephrology: JASN*, 22**,** 1526-1533.
37. CHEN, B., WANG, P., BREM, A., DWORKIN, L., LIU, Z. & GONG, R. 2019. Mineralocorticoid Receptor: A Hidden Culprit for Hemodialysis Vascular Access Dysfunction. *EBioMedicine*, 39**,** 621-627.
38. CRUZ, R. N. d., RETZLAFF, G., GOMES, R. Z. & RECHE, P. M. 2015. Influência Do Diabetes Mellitus Sobre a Perviedade Da Fístula Arteriovenosa Para Hemodiálise. *Jornal Vascular Brasileiro*, 14**,** 217-223.

39. DERAKHSHANFAR, A., GHOLYAF, M., NIAYESH, A. & BAHIRAII, S. 2009. Assessment of Frequency of Complications of Arterio Venous Fistula in Patients on Dialysis: A Two-Year Single Center Study from Iran. *Saudi Journal of Kidney Diseases and Transplantation,* 20**,** 872-875.
40. GHONEMY, T. A., FARAG, S. E., SOLIMAN, S. A., AMIN, E. M. & ZIDAN, A. A. 2019. Vascular Access Complications and Risk Factors in Hemodialysis Patients: A Single Center Study. *Alexandria Journal of Medicine,* 52**,** 67-71.
41. GRAPSA, E. J., PARASKEVOPOULOS, A. P., MOUTAFIS, S. P., VOURLIOTOU, A. J., PAPADOYANNAKIS, N. J., DIGENIS, G. E. & ZEREFOS, N. J. 1998. Complications of Vascular Access in Hemodialysis (Hd) – Aged Vs Adult Patients. *Geriatric Nephrology and Urology,* 8**,** 21-24.
42. HASTAOĞLU, İ. O., HAMDI TOKÖZ & BILGEN, F. 2014. Aneurysmorrhaphy and Plication in the Revisions of Arteriovenous Fistula Aneurysm: Our Clinical Experience. *Turkish Journal of Thoracic and Cardiovascular Surgery,* 22**,** 71-75.
43. KAYGıN, M. A. 2020. Our Experiences with Hemodialysis Arteriovenous Fistula Aneurysm. *Turkish Journal of Vascular Surgery,* 29**,** 121-126.
44. KH, Y., D. M., M. M. & S, F. 2017. Dialysis Adequacy of Chronic Hemodialysis Patients in Zanjan-Iran, 2016. *Preventive Care in Nursing & Midwifery Journal*.
45. LAFRANCE, J. P., RAHME, E., LELORIER, J. & IQBAL, S. 2008. Vascular Access-Related Infections: Definitions, Incidence Rates, and Risk Factors. *Am J Kidney Dis,* 52**,** 982-93.
46. LAZARIDES, M. K., GEORGIADIS, G. S., ANTONIOU, G. A. & STARAMOS, D. N. 2007. A Meta-Analysis of Dialysis Access Outcome in Elderly Patients. *Journal of Vascular Surgery,* 45**,** 420-426.e2.
47. MASUD, A., COSTANZO, E. J., ZUCKERMAN, R. & ASIF, A. 2018. The Complications of Vascular Access in Hemodialysis. *Semin Thromb Hemost,* 44**,** 57-59.
48. MOIST, L. M., HEMMELGARN, B. R. & LOK, C. E. 2006. Relationship between Blood Flow in Central Venous Catheters and Hemodialysis Adequacy. *Clin J Am Soc Nephrol,* 1**,** 965-71.
49. MONROY-CUADROS, M., YILMAZ, S., SALAZAR-BAÑUELOS, A. & DOIG, C. 2010. Risk Factors Associated with Patency Loss of Hemodialysis Vascular Access within 6 Months. *Clinical journal of the American Society of Nephrology: CJASN,* 5**,** 1787-1792.
50. MOREIRA, C. L., CASTRO, A., SILVA, F., ALMEIDA, P., DE MATOS, A. N., SOUSA, C. N., ALMEIDA, R., CABRITA, A. & QUEIRÓS, J. A. 2019. Stenosis and Thrombosis-Unveiled Complications of Buttonhole Cannulation. *Hemodialysis International,* 23**,** E90-E92.
51. MOUSA, A. & BALLARD, J. 2017. Transcutaneous Oxygen Tension: Principles and Applications.
52. QIAN, J. Z., MCADAMS-DEMARCO, M., NG, D. K. & LAU, B. 2020. Arteriovenous Fistula Placement, Maturation, and Patency Loss in Older Patients Initiating Hemodialysis. *Am J Kidney Dis*.
53. ROY-CHAUDHURY, P., SUKHATME, V. P. & CHEUNG, A. K. 2006. Hemodialysis Vascular Access Dysfunction: A Cellular and Molecular Viewpoint. *J Am Soc Nephrol,* 17**,** 1112-27.
54. SCHEUCH, M., FREIIN VON RHEINBABEN, S., KABISCH, A., ENGEßER, J., AHRENDT, S., DABERS, T., KOHLER, C., HOLTFRETER, S., BRÖKER, B. M. & STRACKE, S. 2019. Staphylococcus Aureus Colonization in Hemodialysis Patients: A Prospective 25 Months Observational Study. *BMC Nephrology,* 20**,** 153.
55. STOLIC, R. 2012. Most Important Chronic Complications of Arteriovenous Fistulas for Hemodialysis. *Medical principles and practice: international journal of the Kuwait University, Health Science Centre,* 22.
56. THABET, B. E.-H., EWAS, M., HASSAN, H. & KAMEL, M. 2017. Complications of Arteriovenous Fistula in Dialysis Patients at Assiut University Hospital. *Journal of Current Medical Research and Practice,* 2.
57. THORARINSDOTTIR, H. R., ROCKHOLT, M., KLARIN, B., BROMAN, M., FRAENKEL, C. J. & KANDER, T. 2020. Catheter-Related Infections: A Scandinavian Observational Study on the Impact of a Simple Hygiene Insertion Bundle. *Acta Anaesthesiol Scand,* 64**,** 224-231.
58. WAERME, A. V. B., HADIMERI, H., NASIC, S. & STEGMAYR, B. 2020.

12/15/2020