

Factors Associated with Hemodialysis Patients' Vascular Accesses Failure as Perceived by Nurses and Patients: a retrospective study

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Abstract: Vascular access failure among hemodialysis patients is common and associated with excess mortality, morbidity, and hospital costs. Management of vascular access properly improves the quality of life for hemodialysis (HD) patients and allows for lifesaving hemodialysis treatment. This study aimed to assess factors associated with hemodialysis patients' vascular access failure as perceived by nurses and patients. A descriptive research design (Retrospective study) was utilized for this study. This study was conducted at the hemodialysis unit of Al-Mowasa University Hospital which is affiliated with Alexandria University. Subjects of this study comprised all nurses (25) working at the Hemodialysis Unit of Al-Mowasa University Hospital who were available at the time of data collection, and (95) HD patients, all of them were included in this study. The results revealed that, there was a statistically significant in relation to patient, vascular access, surgery and nurses' practices factors. This study concluded that the most common factors of vascular access failure by the majority of the studied patients and nurses were; insufficient income, followed by prolonged duration of hemodialysis, advanced age, being a male, chronic diseases, anemia, intradialytic complications, smoking, hardworking, using metal needles, lack of vascular access arm exercise, insertion of dialysis needles several times during cannulation, inappropriate practices related to vascular access maintenance, lack of periodical follow up, surgical wound complications, lack of vascular access assessment, unfollowing aseptic technique practices before, during and after cannulation and decannulation, lack of instructions given to the patients for vascular access maintenance, lack of proper management of vascular access complications, were the most common identified factors.

Keywords: vascular access, chronic kidney disease, renal failure, vascular access failure, hemodialysis.

I. INTRODUCTION

End stage renal disease (ESRD) is a progressive and irreversible deterioration of renal function in which the ability of the body failed to maintain metabolic, fluid and electrolyte balance, resulting in uremia or azotemia over a period of months or years (Leung, 2003; Brown & Compher, 2010; Aravind Kumar, Anbuselvan & Ramaprabha, 2014).

Patient with increased signs and symptoms of ESRD is referred early to a transplantation or dialysis centers in course of progressive renal disease. Dialysis is initiated when the patient cannot maintain an acceptable lifestyle with conservative treatment. The prevalence of patients being treated for ESRD globally according to the most recent study is around 10% to 14% in the general population (Vaidya & Aeddula, 2020). In Egypt, the number of ESRD patients with regular HD is steadily increasing, especially among old age patients (El-Zorkany, 2017).

Maintenance hemodialysis is indicated in ESRD, in the presence of uremic signs and symptoms affecting all body systems like nausea or vomiting, severe anorexia, lethargy, confusion, hyperkalemia, fluid retention not responsive to diuretics or fluid restriction, and general weakness (Sinnakirouchenan & Holley, 2011; Parker, 2013). Patients with ESRD can be maintained by dialysis for a long time. Although the dialysis' cost is usually reimbursable. Limitations of the patient's ability to work as a result of illness and dialysis usually impose a significant financial burden on patients and their families (Morton et al., 2012; Roberti et al., 2018).

Dialysis access surgery is the cornerstone of hemodialysis. It includes hemodialysis catheter procedures (CVC), arteriovenous fistula (AVF), and arteriovenous grafts (AVG) (Bloom, Mehrotra, Tuttle & Waikar, 2019). The National Kidney Foundation (NKF) published in 2019 clinical practice guidelines for vascular access (VA) as; surgical referral for vascular access creation should occur when the creatinine clearance of the patients falls below 25 ml/min, serum creatinine above 4 mg/dl, or within one year of anticipated dialysis need (Gilbertson et al., 2005).

Incidence and prevalence of hemodialysis patients associated with vascular access failure in Egypt around 34.5% according to the most recent study which increases hospital costs and patients' need to wait for a long time to create another vascular access and perform hemodialysis through temporary vascular access. All these consequences are caused by vascular access failure (Mohammed, Mohammed, Sayed & Mostafa, 2018).

The common problem that blocking arteriovenous fistula is the primary failure maturation and increasing the morbidity and mortality of patients. Juxta-anastomotic (or inflow) stenosis is the most common cause that leads to primary failure maturation, and percutaneous transluminal angioplasty remains to be the gold-standard intervention with a high successful rate. Intimal hyperplasia (IH) is the major pathophysiologic cause, but the advanced research doubts regarding the impact of IH alone in relation to primary failure (Duque et al., 2017).

Arteriovenous graft (AVG) most commonly made of polytetrafluoroethylene, that is not affected by the maturation problems, but frequently lead to aggressive venous stenosis, most commonly at the graft vein anastomosis, leading to failure and dysfunction (Roy-Chaudhury, Sukhatme & Cheung, 2006; Roy-Chaudhury & Kruska, 2015). They also need intensive procedures as (repeated angioplasty, stent, or stent-graft placement) to maintain patency of vascular access (Lok et al., 2013). In addition, the outcomes of these interventional procedures at the arteriovenous graft on different vascular access patency are minimal, especially in the long-term (Roy-Chaudhury & Kruska, 2015). Cardiovascular disease, hypoalbuminemia, and history of hemodialysis catheter usage are considered risk factors for losing vascular access patency (Ocak et al., 2013).

Complications related to hemodialysis's vascular access have a major effect on morbidity and mortality (Vazquez, 2009; Adib-Hajbagheri, Molavizadeh, Alavi & Abadi, 2014). In addition, hemodialysis patients are hospitalized once or twice per year due to vascular access site complications (Lafrance, Rahme, Leloirier & Iqbal, 2008; Adib-Hajbagheri et al., 2014). Which account for 14%–17% of hospitalizations per year according to the most recent study for hemodialysis patients (Kaushal & Wilson, 2017).

The most common complication of vascular access is infection (Saeed Abdulrahman, Al-Mueilo, Bokhary, Ladipo & Al-Rubaish, 2002; Saint-Lebes, Dubuis, Deglise, Francois & Corpataux, 2014), as a result of contamination during the creation of the access and repeated use of the access (Akoh, 2011; Saint-Lebes et al., 2014). Another most common acute complication in relation to vascular access is spontaneous bleeding. In whom the primary mechanisms of hemostasis are compromised including dysfunction of thrombocytopenia and platelets. Spontaneous bleeding can lead to chronic anemia, which is common in uremic patients, also negatively influences the rheological components of the platelets' vascular wall interaction (Florin, Stiru, Bulescu, Bubenek & Anton, 2013).

Formation of hematoma associated with or without active bleeding may lead to surgical wound exploration. If the hematoma is small and the arteriovenous fistula's thrill is present, the patient should be monitored regularly, and there is no surgical indication can be considered. If the hematoma is large and the thrill of vascular access is weak or absent, the hematoma of vascular access should be evacuated, followed by closing the bleeding source (Florin et al., 2013).

Another most common complication of VA is thrombosis which can lead to several missed dialysis sessions, increased patient admission, and placement of a temporary hemodialysis catheter (Quencer & Oklu, 2017).

Three steps can be considered to assist nurses in identifying risk factors of patients in relation to vascular access failure including risk factors related to patients, risk factors related to surgery, and risk factors related to nurses' practices. Regarding patients' related risk factors, the recent research illustrated that the younger the age, the longer the duration of vascular access survival. One of the factors for patent vascular access is the site of access in the forearm. As restoration of vascular access in the forearm is associated with a better chance of preserving patent VA (Hayakawa et al., 2007).

Regarding the presence of associated diseases as cardiac disease, it has an adverse effect on the maturation of fistula due to lack of cardiac output and blood flow to the vascular access, worse outcomes as a result of this effect (Righetti, Ferrario, Serbelloni, Milani & Tommasi, 2009; Hudson, Johnson & Viecegli, 2019). On the other hand, diabetes mellitus (DM) is associated with increased risk of peripheral arteries disease and intimal hyperplasia (IH), with these risk exaggerated more in patients with ESRD leading to a significant rate of vascular access failure (Diehm et al., 2010; Hudson et al., 2019).

A higher risk of arteriovenous fistula failure between hypertensive patients who were treated with angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs) compared to patients who did not receive these drugs. Smoking, severe anemia, diabetes mellitus, and old age are the main risk factors of vascular access failure. So, HD patients should maintain the target hemoglobin level between 10 g/dL to 12 g/dL to prevent anemia (Gheith & Kamal, 2008).

Obesity may be another factor that affects the creation of arteriovenous graft over arteriovenous fistula. Obesity is common in HD patients. When the arteriovenous fistula is established in obese patients, it usually needs a successive transposition procedure to make it suitable for cannulation by the HD nurses (Inkollu et al., 2016). Hypoalbuminemia is also associated with early vascular access failure (Tanaka et al., 2016).

Regarding surgical related risk factors, the factors that affecting the anastomosis and consequently the outcomes of arteriovenous fistula include both the surgeon's experience in creating the AVF, and the practical issues associated with using and managing the fistula. The formation of arteriovenous fistula is difficult, but several studies indicated that there was a higher rate of successful arteriovenous fistula if the surgery is made by an experienced vascular surgeon (Goodkin, Pisoni, Locatelli, Port & Saran, 2010).

Regarding risk factors in relation to nurses' practices, it was established that cannulation of the fistula is a procedure that needs important skills development and if not done well, it can negatively have consequences outcomes for patients. Complications associated with mis-cannulation or an inability to needle the AVF can lead to increased usage of central venous catheters (Harwood, Wilson & Oudshoorn, 2016).

Proper management of vascular access improves the quality of life for hemodialysis patients and allows for lifesaving HD treatments (Viecegli et al., 2018). It is important that the nurse must well recognize and adhere to the principles of port access, port identification, assessment and preparation of access site, types, styles of needles, flushing, care and maintenance of access such as dressing changes and monitoring hemodialysis machine blood pump speed not exceed than 300 mL/min (good observation) (MacRae et al., 2016a). Also, the nurse needs to well understand and be aware of potential complications and methodologies of VA to prevent any complications of vascular access (Blackburn & Van Boxel, 2012). Moreover, vascular access care and management need continuous training for nurses, patients, and doctors (Parisotto et al., 2017).

The study aimed to assess factors associated with hemodialysis patients' vascular accesses failure as perceived by nurses and patients: a retrospective study.

II. MATERIALS AND METHODS

Materials

Research Design: A descriptive research design (Retrospective study) was utilized for this study.

Setting: This study was conducted at the Hemodialysis Unit of Al-Mowasa University Hospital which is affiliated to Alexandria University.

Subjects: Subjects of this study comprised all nurses (25) working at the above-mentioned setting who were available at the time of data collection, and (95) HD patients who were selected based on the following inclusion criteria: Adult

patients diagnosed with chronic renal failure aged from 20 to 60 years with vascular access failure and complicated vascular access (Pre-failure vascular access), on maintenance hemodialysis, alert and able to communicate.

Tools of the study:

Two tools were used to collect necessary data for the study.

Tool 1: Factors associated with hemodialysis patients with vascular access failure. An interview schedule: This tool was adapted by the researcher from (Gheith & Kamal, 2008; Parisotto et al., 2014; Andrea, Ricardo, Jasmin & Sanabria, 2019; Hudson et al., 2019), and certain modifications were done to identify risk factors that lead to vascular access failure as perceived by patients. This tool consisted of the following three parts:

Part I: Bio socio-demographic characteristics and clinical data:

Bio socio-demographic data was collected to identify personal data of HD patients as age, gender, level of education, occupation, marital status, income, residence, race, housing, etc.

Clinical data was comprised, past and present health history as medical diagnosis, presence of chronic disease, previous trauma, previous hospitalization, and its causes, presence of surgical history, associated manifestations or diseases with chronic kidney disease, family and medication history, pre-surgical doppler, starting of hemodialysis treatment per years, number of hemodialysis sessions per week, total hemodialysis sessions hours per week, presence of any complications during hemodialysis sessions, blood pump speed during hemodialysis session, physical activity, bad habits, sleep pattern, appetite, body mass index, and type, site, time of failure, pre-failure vascular access, etc.

Part II: Factors associated with hemodialysis patient's vascular access failure as perceived by patient:

This part included four items to identify factors associated with hemodialysis patient vascular access failure and complicated vascular access as perceived by patient, presented as the following: (1) factors related to patients as; age, gender, race, associated diseases or manifestations related to chronic renal failure (CRF) or chronic diseases not related to (CRF), presence of complications during hemodialysis session, duration of hemodialysis session per hours, smoking, hardworking, presence of vascular diseases history related to patients and their family...etc. (2) factors related to vascular access as; type of dialysis needles used, number and duration of insertion, exercise training at vascular access arm, time of vascular access usage after the creation and presence of some inappropriate practices related to vascular access maintenance...etc. (3) factors related to surgical intervention as; site of vascular access, pre-surgical doppler, periodical follow up, and surgical wound complications...etc. (4) factors related to nurses' practice as; pre and post-procedure assessment (cannulation and decannulation), following aseptic techniques during cannulation and decannulation procedure, assessment and monitoring of access during hemodialysis session, pressure and bleeding management after decannulation, giving instructions to patients for vascular access maintenance, knowledge of nurses related to vascular access care, and measures to deal with vascular access complications...etc.

Part III: Patient's laboratory investigations:

This part was aimed to identify factors associated with hemodialysis patient vascular access failure and complicated vascular access as perceived by the patient. It included complete blood picture (CBC), kidney function test (blood urea, serum creatinine, and blood urea nitrogen), and coagulation profile (PT-PTT-INR), blood glucose level for diabetic patients only.

Scoring system: For each section, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into a percent score. Each question has three responses: (1) disagree, (2) uncertain, (3) agree, (0) not applicable.

Tools II: This tool was developed by the researcher after a review of literature (Vachharajani, 2012; Polkinghorne et al., 2013; Adib-Hajbagheri et al., 2014; Harwood, Wilson & Goodman, 2017; Canaud et al., 2019; Coventry et al., 2019) to identify risk factors that lead to vascular access failure as perceived by nurses. It consisted of two parts as the following:

Part I: Bio socio-demographic characteristics of nurses

Bio socio-demographic data was collected to identify personal data of HD nurses as age, gender, level of education, marital status, income, years of experience in dialysis unit and attendance of educational / training courses or programs...etc.

Part II: Factors associated with hemodialysis patient's vascular access failure as perceived by nurses:

This part included four items to identify factors associated with hemodialysis patient vascular access failure and complicated vascular access as perceived by nurses, presented as the following: (1) factors related to patients as; age, gender, race, associated diseases or manifestations related to chronic renal failure (CRF) or chronic diseases not related to (CRF), presence of complications during hemodialysis session, duration of hemodialysis session, smoking, hardworking, presence of vascular diseases history related to patients and their family...etc. (2) factors related to vascular access as: size and type of dialysis needles, level of vascular access maturation, type of vascular access, exercise training at vascular access arm, number and duration of needles insertion, and presence of some inappropriate practices related to vascular access maintenance..etc. (3) factors related to surgical interventions as: presence of surgical wound complications, pre-surgical doppler, periodical follow-up and site of vascular access..etc. (4) factors related to nurses' practice as; pre and post-procedure assessment (cannulation and decannulation), following aseptic techniques during cannulation and decannulation procedure, assessment and monitoring of access during hemodialysis session, pressure and bleeding management after decannulation, monitoring machine speed pump, giving instructions to the patients for vascular access maintenance, knowledge of nurses related to vascular access care, and measures to deal with vascular access complications...etc.

Scoring system: For each section, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into a percent score. Each question has three responses: (1) disagree, (2) uncertain, (3) agree, (0) not applicable.

Methods**1. Written approval:**

- Approval from ethical committee, Faculty of Nursing, Alexandria university was obtained.
- An official letter was issued from the Faculty of Nursing, Alexandria University to the study setting to obtain their permission to collect the necessary data.
- An official permission was obtained from the directors and head of the departments at the selected hospital setting after explanation of the aim of the study.

2. Tools of study:

- Tool I was adapted, and Tool II was developed after review of relevant related literature.
- Factors associated with hemodialysis patients' vascular accesses failure as perceived by patients were assessed, using tool I.
- Factors associated with hemodialysis patients' vascular accesses failure as perceived by nurses were assessed, using tool II.
- The adapted and developed tools were translated into Arabic language.
- The content of constructed tools was revised by a jury of 5 experts in the field of Medical Surgical Nursing Department, Faculty of Nursing, Alexandria University to test the content validity, completeness, and clarity of items. Comments and suggestions of July were considered, and the tools were modified accordingly.

3. Reliability: The reliability of the tools was tested using Cronbach Alpha Test. Reliability coefficient for tool I and tool II were 0.992.

4. Pilot study: A pilot study was undertaken before starting the data collection. It was carried out on 5% of patients and nurses (5 patients and 3 nurses) to test the feasibility and the applicability of the tools and to identify the difficulties that may be faced during the application of the tools. Those patients and nurses were excluded from the sample. Data was started and continued for a period of 3 months from the beginning of May to the end of July 2020.

5. Ethical considerations:

- Written informed consent was obtained from nurses and patients participating in the study, after explaining the purpose of the study.

- Confidentiality of data was maintained, and patient was assured that he/she has the right to be withdrawn at any time from the study.
- The anonymity and privacy of patients were ascertained.
- Witness written informed consent was obtained from director of hemodialysis unit, after an explanation of the purpose of the study.

6. Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution, quantitative data were described using range (minimum and maximum), mean, standard deviation. The significance of the obtained results was judged at the 5% level. The used tests were: Student t-test for normally distributed quantitative variables, to compare between two studied groups, F-test (ANOVA) for normally distributed quantitative variables, to compare between more than two groups and Cronbach's Alpha which reliability statistics was assessed using Cronbach's Alpha test.

III. RESULTS

Table 1: Shows distribution of the studied patients according to bio sociodemographic data of patients: It was found that more than one-third of the studied patients were 41.1% in the age group of 50-60 years. In relation to gender, it was noticed that more than two thirds of the studied patients 65.3% were males. Concerning the educational level, it was evident that more than two-thirds of the studied patients 66.3% had university study. Regarding the patient's occupation, it was obvious that more than one-third of the studied patients were retired 36.8%, and more than half of the studied patients 54.7% were single. In relation to patient's income, it was found that the majority of the studied patients 88.4% had insufficient monthly income to fulfill the daily requirements. Regarding area of residence and race, this table revealed that the majority of the studied patients (77.9%, 83.1%) respectively, were coming from urban areas and white skin.

Table 1: Distribution of the studied patients according to bio sociodemographic data of patients (n=95)

Bio socio-demographic characteristics	No.	%
Age		
- 20 > 30 yrs	9	9.5
- 30>40 yrs	34	35.9
- 40 > 50 yrs	13	13.7
- 50-60 yrs	39	41.1
Gender		
- Male	62	65.3
- Female	33	34.7
Level of education		
- Illiterate	10	10.5
- Read and write.	2	2.1
- Primary	1	1.1
- Diploma	15	15.8
- Secondary	4	4.2
- University	63	66.3
Occupation		
- Manual	3	3.2
- Professional	33	34.7
- Housewife	4	4.2
- Retirement	35	36.8
- Not working	20	21.1

Marital status		
- Single	52	54.7
- Married	24	25.3
- Widow / Divorced	19	20
Income		
- Insufficient	84	88.4
- Sufficient	11	11.6
Residence		
- Rural	21	22.1
- Urban	74	77.9
Race (skin color)		
- Black skin	16	16.8
- White skin	79	83.1

Table 2: Illustrate distribution of the studied patients according to clinical data: Regarding medical history (chronic diseases), it was obvious that more than two-thirds 64.2% of the studied patients have chronic diseases. Also revealed that the highest percentage of the studied patients 84.2% had anemia as an associated manifestation. Regarding the duration of the hemodialysis session, it was evident that more than two-thirds of the studied patients 67.4% started their sessions 10 years or more ago. Concerning complications during hemodialysis sessions, it was evidenced that more than three-quarters of the studied patients 75.8% had complications during hemodialysis sessions. In relation to site, type, and time of vascular access, it was obvious that more than one-half of the studied patients 52.4% failure occurred in AVF right lower arm from one year to less than 5 years in 48.8% of the studied patients. Also, it was seen that more than one-third of the studied patients had abnormal Hg level in blood 84.2% (blow than normal level)

Table 3: Distribution of the studied patients according to clinical data (n=95)

Clinical data	No	%
Medical history (chronic diseases)		
- No	34	35.8
- Yes	61	64.2
Chronic diseases (n=61)		
- Hypertension	43	32.6
- Hypotension	14	13.7
- DM	9	3.2
- CHF	5	1.1
- Hyperthyroidism	2	2.1
- Hypothyroidism	1	1.1
Previous trauma		
- No	87	91.6
- Yes	8	8.4
Previous hospitalization		
- No	84	88.4
- Yes	11	11.6
Previous surgery		
- No	94	98.9
- Yes	1	1.1

Clinical data	No	%
Associated manifestations or diseases with chronic renal failure or not related		
- No associated manifestations	9	9.5
- Anemia	80	84.2
- Osteoporosis	6	6.3
Family history of diseases		
- No	73	76.8
- CKD	8	8.4
- Hypertension	4	4.2
- Hypotension	2	2.1
- DM	8	8.4
Use of over counter medications		
- No	88	92.6
- Yes (analgesics)	7	7.4
Was doppler carried out on vascular system before vascular access creation?		
- No	0	0.0
- Yes	95	100
Starting of hemodialysis treatment (year)		
- <5 yrs	3	3.2
- 5- yrs	28	29.5
- ≥ 10 yrs	64	67.4
Number of hemodialysis sessions (week)		
- 1-2 session	4	4.2
- 3-4 session	91	95.8
Total Hemodialysis sessions hours (week)		
- 4 > 12 hours	4	4.2
- 12 > 20 hours	91	95.8
Complications occurred during hemodialysis session		
- No	23	24.2
- Yes	72	75.8
Complications occurred during hemodialysis session (n=72)		
- Hypotension	55	57.9
- Hypertension	17	17.9
Blood pump speed during hemodialysis session		
- 200> 300 ml/min	23	24.2
- 300≥400 ml/min	72	75.8
Physical activity		
- Active	56	58.9
- Partial dependent	23	24.2
- Inactive	16	16.8

Clinical data	No	%
Smoking		
- No	71	74.7
- Yes	24	25.3
Have problems in sleep pattern		
- No	88	92.6
- Yes	7	7.4
Have problems in appetite		
- No	88	92.6
- Yes	7	7.4
BMI		
- Underweight	3	3.2
- Normal	84	88.4
- Overweight	3	3.2
- Obese	5	5.3
Site and type of vascular access failure (n=84)		
- AVF right upper arm	22	26.2
- AVF right middle arm	8	9.5
- AVF right lower arm	44	52.4
- AVF left upper arm	5	6.0
- AVF left middle arm	3	3.6
- AVF left lower arm	2	2.4
Time between usage of vascular access and failure (n=84)		
- 6 months	3	3.6
- 6 months > 1 yrs	11	13.1
- 1 yrs > 5 yrs	41	48.8
- 5 yrs > 10 yrs	7	8.3
- 10 yrs <	7	8.3
- Before usage	15	17.9
Abnormal laboratory investigations		
- Hemoglobin	80	84.2

Figures 1: Denotes distribution of the studied patients and nurses according to factors related to patients: In relation to figure (1a), regarding advanced age, it was found that nearby half of the studied patients 49.5% and nearby three quarters of the studied nurses 72% were agreed that advanced age is one cause of vascular access failure. Regarding gender, it was found that more than one half of the studied patients 58.9% and the majority of the studied nurses 80% were agreed that failure occur more common in males. Concerning smoking, more than two thirds of the studied patients 70.5% and the majority of the studied nurses 84% were agreed that smoking can be one cause of vascular access failure. In relation to hardworking as builder or clean worker, more than one half of the studied patients 57.9% were uncertain that hardworking can be one cause of vascular access failure, while the majority of the studied nurses 72% were agreed about that. Regarding figure (1b), presence of associated diseases or manifestations related to chronic renal failure, the majority of the studied patients and nurses, were agreed that obesity, diabetes mellitus, hypotension, anemia, and hypertension can be causes of vascular access failure. Concerning (figure 1c and d), presence of complications during hemodialysis session, it was found that the majority of the studied patients and nurses, were agreed that hypotension and hypertension as complications during hemodialysis session can be causes of vascular access failure.

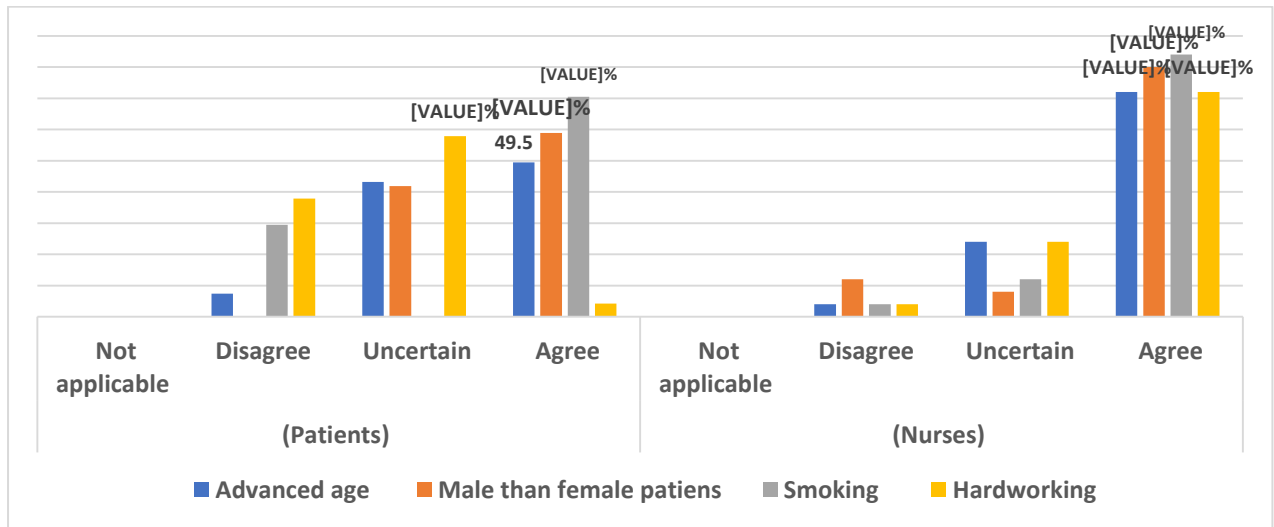


Figure (1a): Distribution of the studied patients and nurses according to factors related to patients.

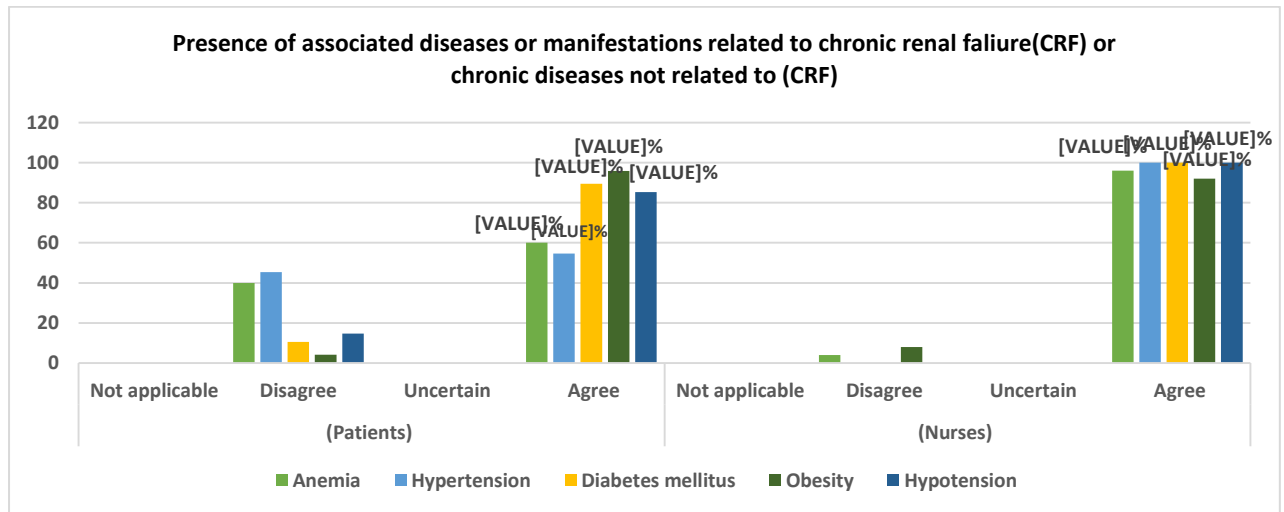


Figure (1b): cont. Distribution of the studied patients and nurses according to factors related to patients

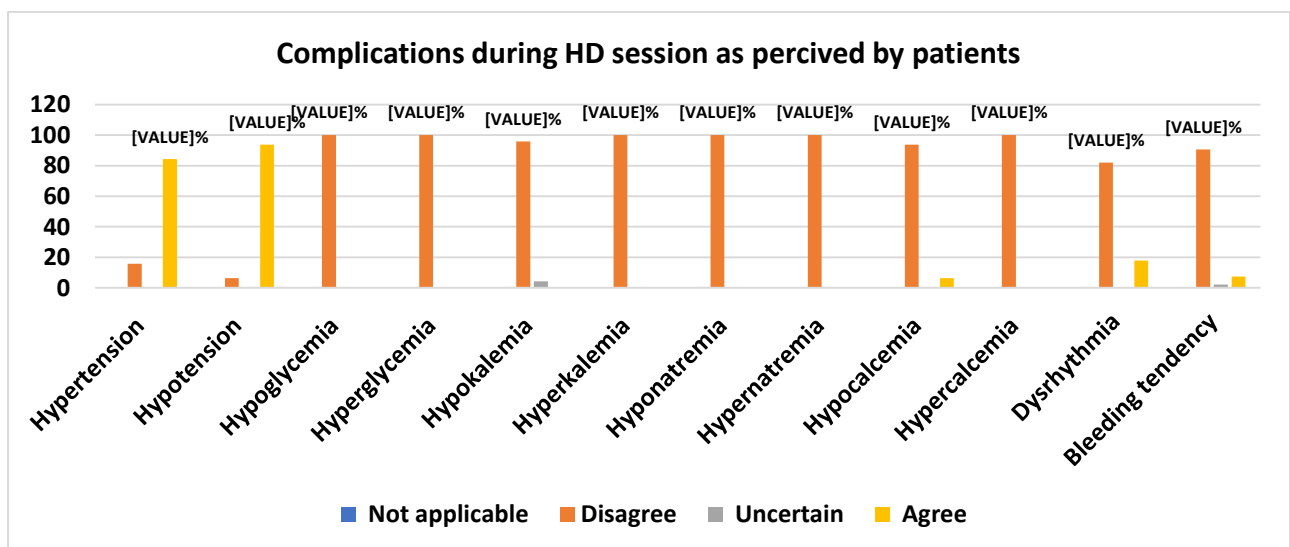


Figure (1c): cont. Distribution of the studied patients according to factors related to patients.

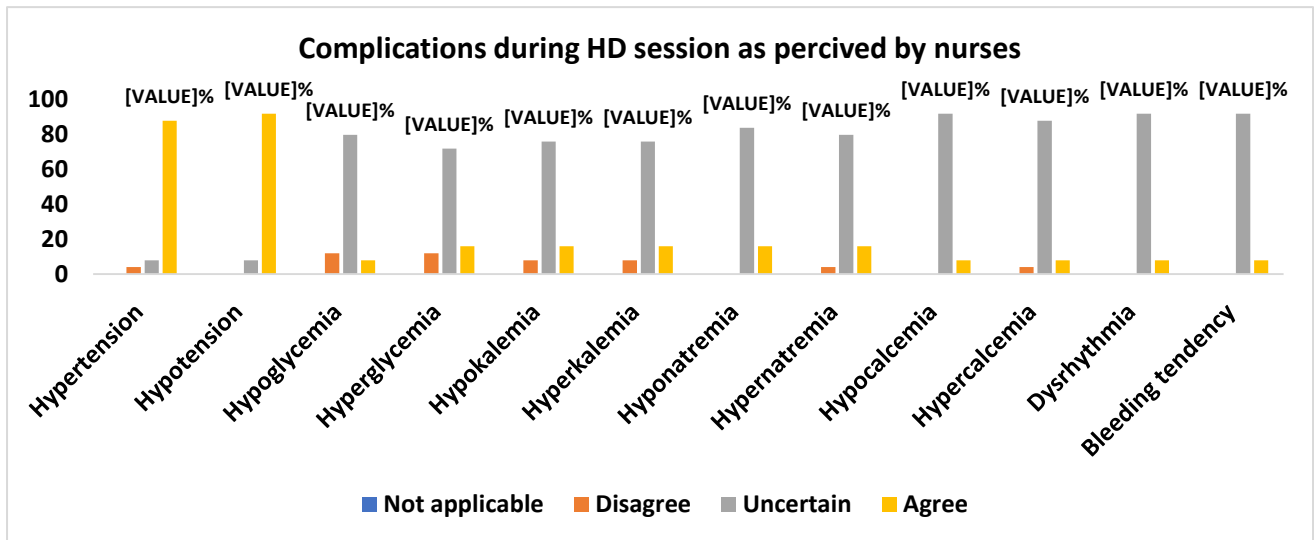


Figure (1d): cont. Distribution of the studied nurses according to factors related to patients.

Figures (2): Illustrates distribution of the studied patients according to factors related to vascular access and surgical interventions: In relation to figure (2a), concerning types of dialysis needles used, it was obvious that more than three quarters of the studied patients 82.1% and studied nurses 80% were agreed that using metal needles during cannulation procedure is one cause of vascular access failure. Regarding lack of vascular access arm exercise, it was found that more than two thirds of the studied patients 65.3%, and the majority of the studied nurses 84% were agreed that lack of vascular access arm exercise is one cause of vascular access failure. Concerning insertion of dialysis needle several times during cannulation procedure, it was seen that the majority of the studied patients 92.6% and more than half of the studied nurses 56% were agreed that insertion of dialysis needle several times during cannulation procedure is one cause of vascular access failure. Concerning lack of periodical follow-up for report any complications, it was seen that the majority of the studied patients 93.7% and two thirds of the studied nurses 60% were agreed that lack of periodical follow-up for report any complications is one cause of vascular access failure. In relation to figure (2b), the presence of some inappropriate practices related to vascular access maintenance, it was found that nearly three quarters of the studied patients and nurses considered these inappropriate practices were causes of vascular access failure.

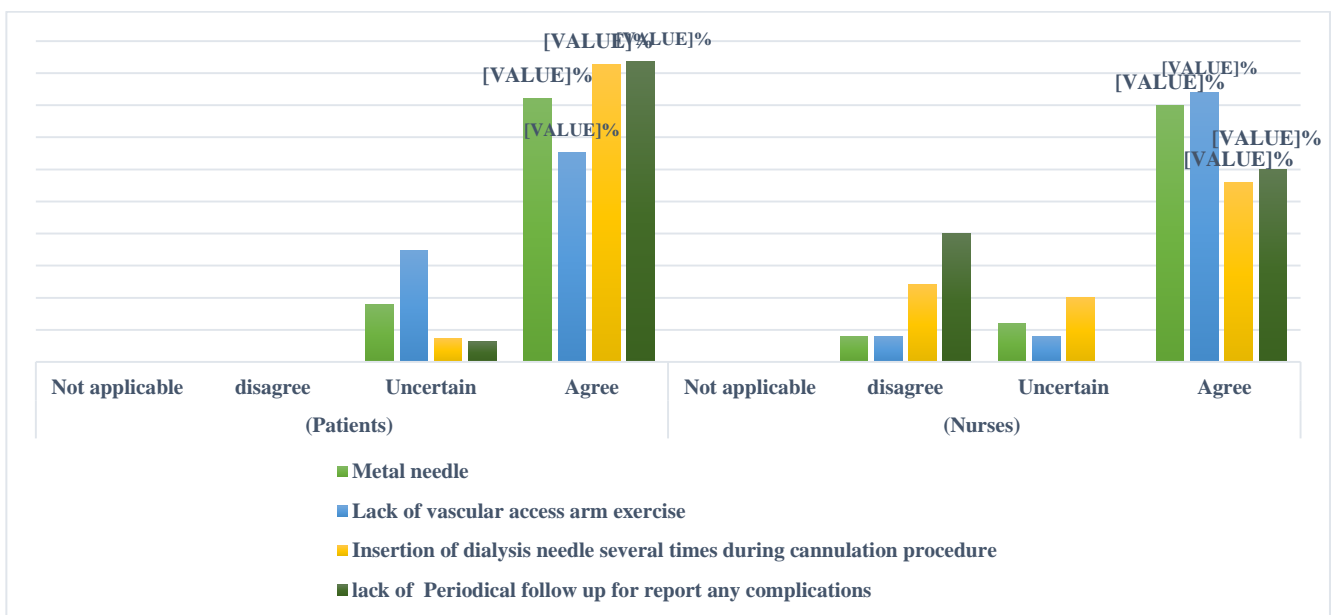


Figure (2a): Distribution of the studied patients according to factors related to vascular access and surgical interventions.

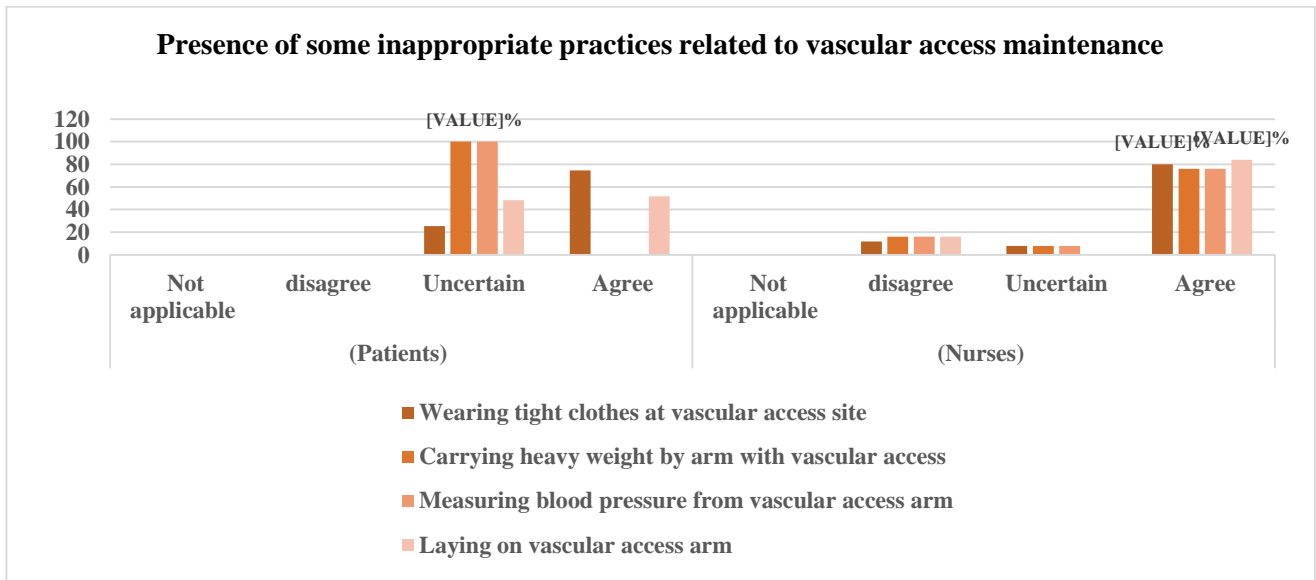


Figure (2b): cont. Distribution of the studied patients according to factors related to vascular access and surgical interventions.

Figures (3): Conveys distribution of the studied patients and nurses according to factors related to nurses' practice: In relation to figure (3 a,b,c and d), The results of the present study denoted that the majority of the studied patients as well as nurses considered factors of vascular access failure were unfollowing aseptic technique during cannulation and decannulation procedure as site of VA cleaned with soap and water, wearing; sterile gloves, face mask, overhead and gown by staff and hand hygiene performed by staff. In relation to figure (3 e and f), as the factors of vascular access failure are unfollowing vascular access assessment before, during, and after cannulation and decannulation, both studied patients and nurses were agreed that lack of vascular access assessment in form of palpation (thrill) and auscultation (bruit) are causes of vascular access failure. Regarding instructions given to patients for vascular access maintenance, it was found that the majority of the studied patients 90.5%, and nearly three-quarters of the studied nurses 72% were disagreed about the presence of instructions given to the patients for vascular access maintenance. In relation to proper management of vascular access complications by nurses, the present study results denoted that, the majority of the studied patients and nurses were disagreed about the presence of proper management of vascular access complications by nurses.

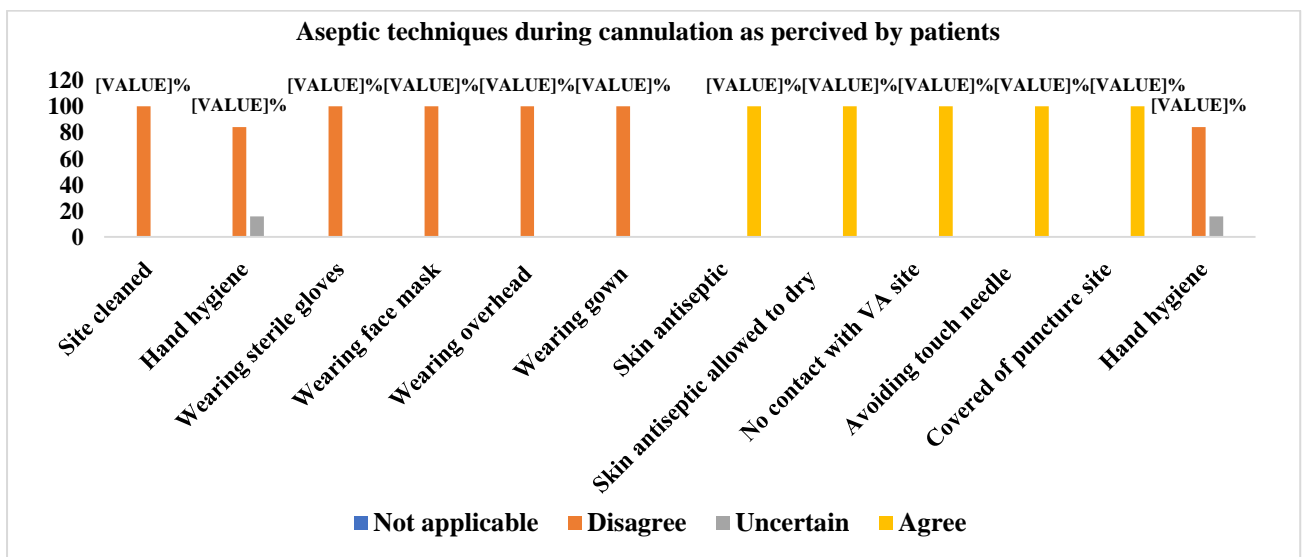


Figure (3a): Distribution of the patients according to factors related to nurses' practice.

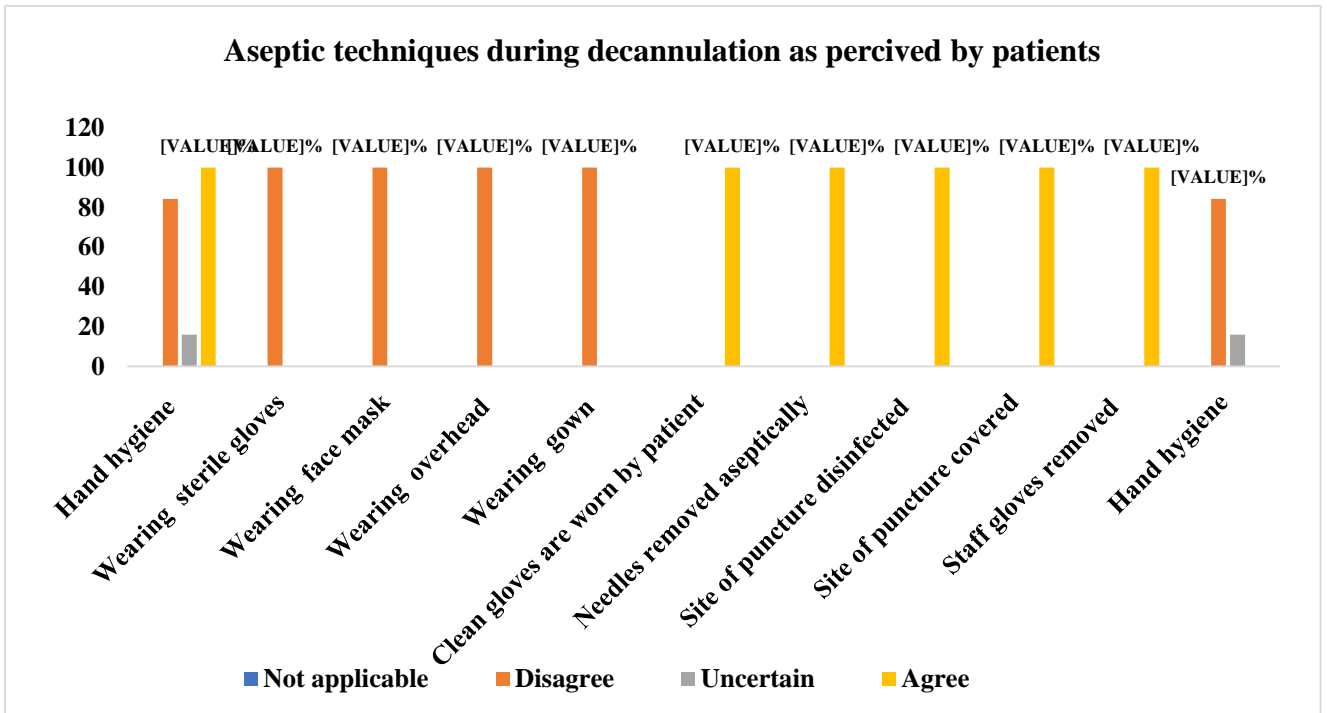


Figure (3b): cont. Distribution of the patients according to factors related to nurses' practice

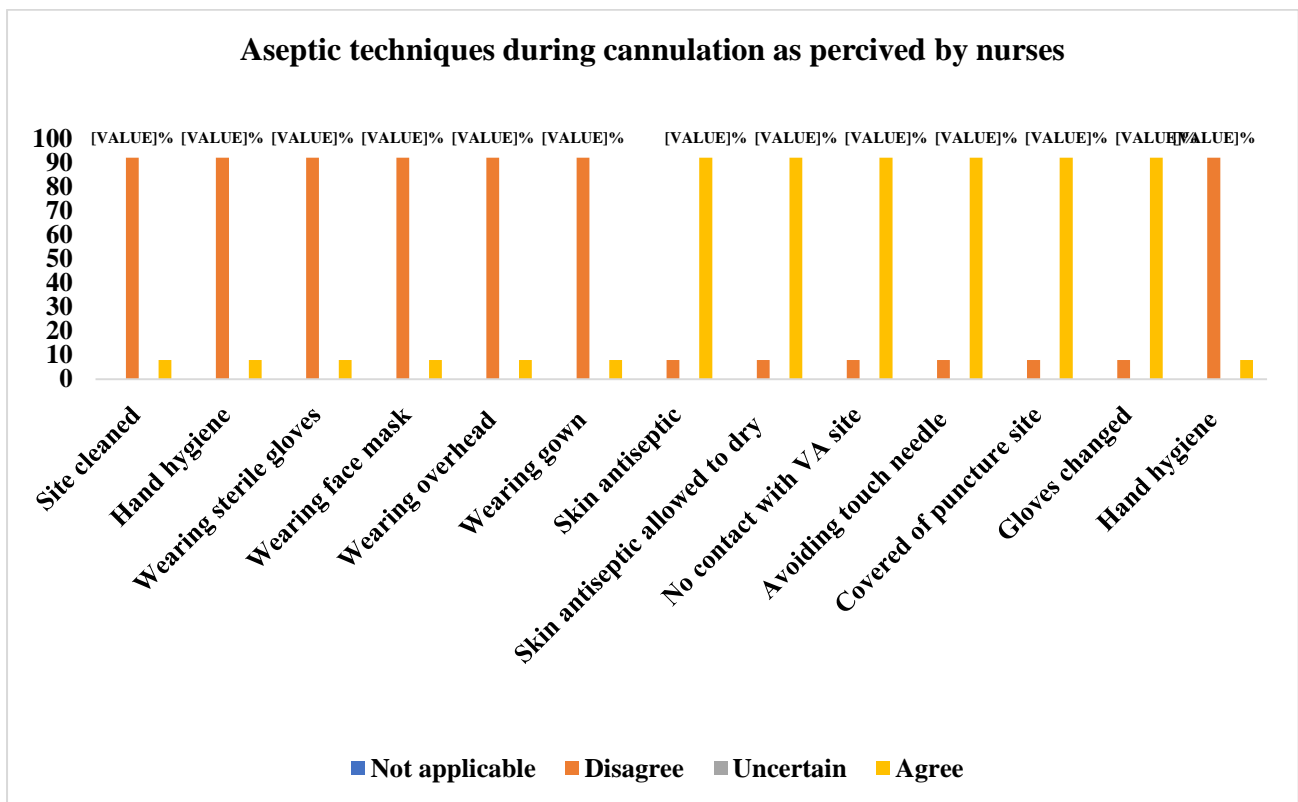


Figure (3c): cont. Distribution of the studied nurses according to factors related to nurses' practice.

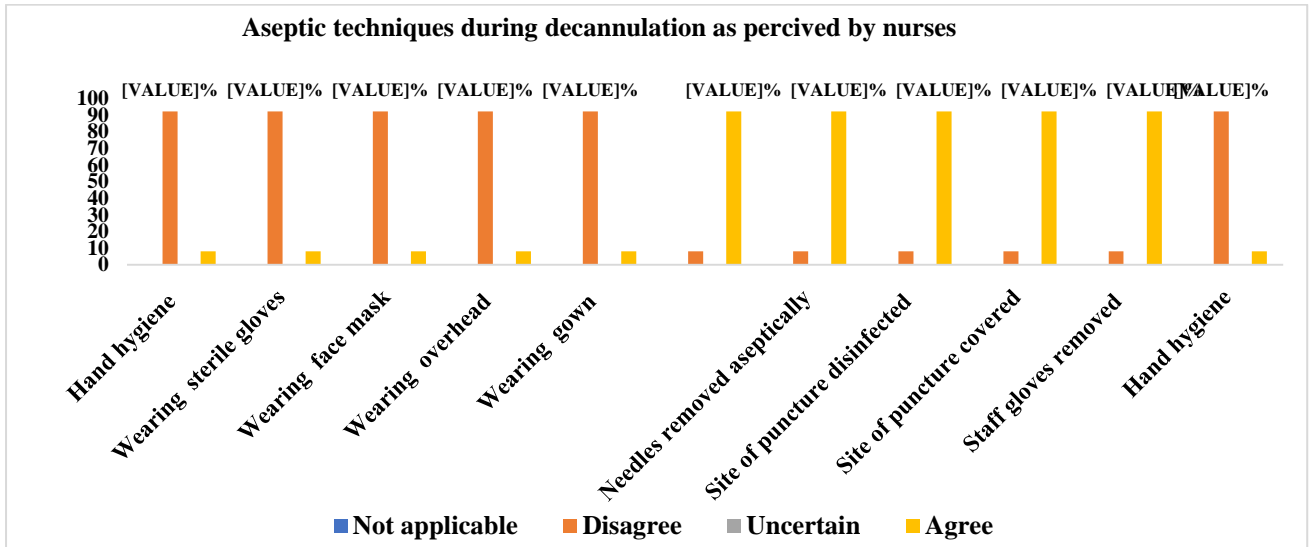


Figure (3d): cont. Distribution of the studied nurses according to factors related to nurses' practice.

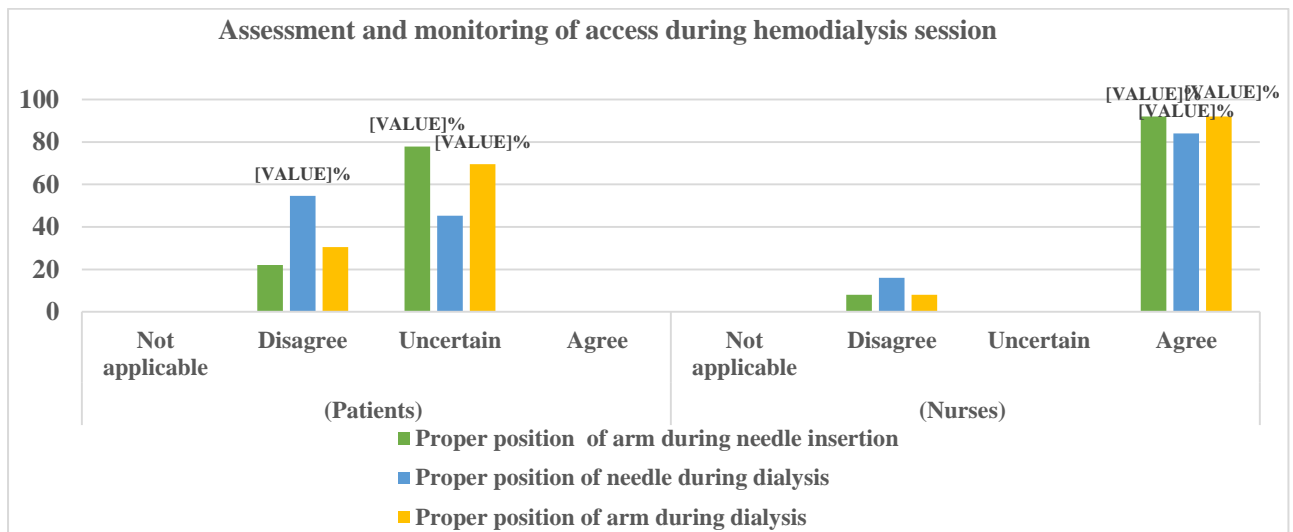


Figure (3e): cont. Distribution of the studied patients and nurses according to factors related to nurses' practice.

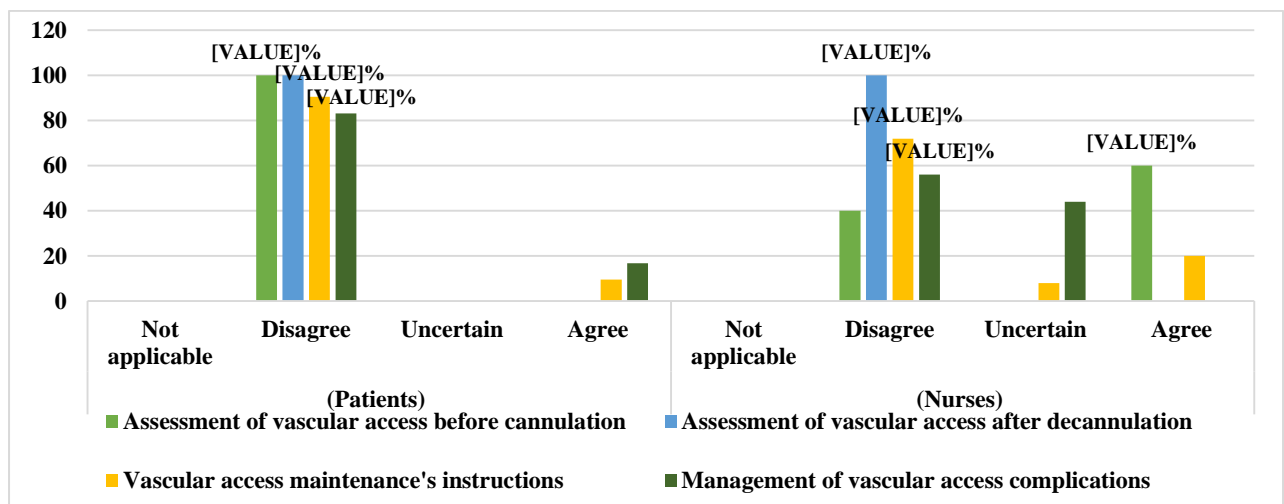


Figure (3f): cont. Distribution of the studied patients and nurses according to factors related to nurses' practice.

Table (3): Denotes relation between factors that lead to vascular access failure and bio socio-demographic data of patients and nurses: In relation to nurses, this table revealed a significant relation between the age and overall factors ($F = 4.094, P=0.031$). And between years of nurses’ experience in HD unit and overall factors ($F = 15.657, P=0.000$). In relation to patients, there was a significant relation between the level of patient’s education and overall factors ($F = 2.553, P=0.033$),

Table (8): Denotes relation between factors that lead to vascular access failure and bio socio-demographic data of patients and nurses.

Bio socio-demographic data of patients and nurses	N	Factors associated with hemodialysis patient’s vascular access failure as perceived by patient and nurses									
		Patients		Vascular access		Surgical intervention		Nurses’ practices		Overall Factors	
		Mean ± SD.		Mean ± SD.		Mean ± SD.		Mean ± SD.		Mean ± SD.	
Age of nurses											
20 > 30 yrs	10	88.30	3.30	30.30	1.89	13.80	1.03	93.00	2.79	225.40	6.40
30>40 yrs	9	89.00	5.55	27.22	5.76	13.22	0.67	90.22	4.12	219.67	11.20
40 > 50 yrs	6	82.00	4.43	30.83	2.40	13.33	1.51	80.83	22.48	207.00	20.30
F(p)		5.047(0.016*)		2.121(0.144)		0.787(0.468)		2.309(0.123)		4.094(0.031*)	
Years of nurse’s experience in HD unit											
≤10 yrs	7	87.29	2.63	30.29	2.29	13.29	0.49	93.86	2.41	224.71	6.87
10>20 yrs	10	90.90	4.12	29.20	4.73	13.80	1.14	90.00	3.83	223.90	9.67
20>30 yrs	6	81.83	4.40	27.50	4.81	12.67	0.82	94.17	5.27	216.17	8.13
≥40 yrs	2	82.50	0.71	32.00	0.00	15.00	0.00	52.50	0.71	182.00	0.00
F(p)		8.479(0.00*1)		0.822(0.496)		4.226(0.017*)		68.577 (0.000*)		15.657(0.000*)	
Level of patient’s education											
Illiterate	10	50.10	2.73	22.70	1.16	24.00	1.63	60.80	1.81	157.60	3.41
Read and write	2	51.00	0.00	21.50	0.71	22.50	3.54	63.00	1.41	158.00	5.66
Primary	1	48.00	-	23.00	-	24.00	-	60.00	-	155.00	-
Diploma	15	48.53	2.53	21.87	1.46	23.40	2.35	59.87	1.25	153.67	3.89
Secondary	4	48.50	3.42	21.50	1.73	22.00	2.31	59.00	1.41	151.00	5.10
University	63	49.13	2.67	21.90	1.42	23.30	1.85	59.68	2.10	154.02	3.83
F(p)		0.692(0.631)		0.820 (0.539)		0.701 (0.624)		1.791 (0.123)		2.553(0.033*)	

IV. DISCUSSION

Vascular access care and management need continuous training for nurses, patients, and doctors. Nurses and patients play an important role in the maintenance of VA and VA's longevity. Good expertise is required to allow the nurse to assess, prepare, manage, and evaluate the treatment that given to the HD patients before, during, and after cannulation and management of complications properly. Cannulation of vascular access is an essential skill for hemodialysis nurses and failure to perform cannulation procedure properly may lead to serious complications for HD patients and negatively effect on vascular access (Parisotto et al., 2017).

In relation to level of patient’s education, the results of the present study revealed that more than two-thirds of the studied patients had university degrees. This may be related that Al-Mowasa hospital serves a certain class of patients who have health insurance with upper and intermediate qualifications. This result was contradicted by Yolgösteren (2020), who reported that a low level of education is associated with a low rate of vascular access patency.

Regarding patient's income, the present study findings revealed that the majority of the studied patients had insufficient monthly income to fulfill the daily requirements. This finding may be related to the negative effect of CRF on health conditions which contributed to lack of occupation and increased poverty. This finding matched with Nicholas, Kalantar-Zadeh, and Norris (2015), who concluded a strong correlation between poverty and complications of CRF.

Aščerić et al. (2019) denoted that, there are some risk factors of vascular access failure as; hyperlipidemia, diabetes mellitus (DM), and hypertension, it was obvious that more than two-thirds of the studied patients have chronic diseases, and more than one-third of the studied patients had hypertension. This finding was matched with Monroy-Cuadros, Yilmaz, Salazar-Bañuelos, and Doig (2010) and Mehmood et al. (2016), who stated that patients who treated with antihypertensive therapy as angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs) were at risk for vascular access failure than those who were not.

In contrast to the present study, Ghonemy, Farag, Salem, Amin and Zidan (2016a), Paulhus (2020) and Mehmood et al. (2016) reported that in their studies, DM is a significant risk factor for the incidence and prevalence of vascular access's infection and impairment of peripheral blood supply. Regarding Hg level, the result concluded that the majority of the studied patients had anemia. This may be related to the pathophysiology of CRF as an associated manifestation related to erythropoiesis deficiency (Babitt & Lin, 2012), and unhealthy diet due to lack of instructions given to the patients about healthy diet. This finding was matched with Wen et al. (2019), who stated that anemia is one cause of vascular access failure.

Regarding the relation between the duration of hemodialysis session and incidence of VA failure, the results of the present study found that more than two-thirds of the studied patients who were on HD sessions for 10 years or more ago, were more vulnerable to VA failure rather than those who were on HD session for less than 10 years ago. This may be related to frequent and prolonged exposure to trauma-related to cannulation and decannulation procedure and vascular access complications (Coventry et al., 2019). This finding was matched with Ghonemy et al. (2016a), who stated that increased duration of hemodialysis session is one cause of vascular access failure.

AVF remains the first option recommended for chronic HD patients. This is the first choice for survival of access and has a low rate of morbidity and mortality (Santoro et al., 2014). In addition, the lower arm radiocephalic fistula is the first vascular access recommended (RCF) followed by the second option, brachiocephalic (BCF), then the brachiocephalic (BBF) is the third option of fistula recommended (Laminat Medical, 2017). In relation to site and type of vascular access, the present study findings revealed that more than one half of the studied patients, failure occurred in AVF at right lower arm. This result may be related to that AVF were more commonly used at Al-Mowasa hospital rather than AVG.

This result was contradicted by Brahmhatt et al. (2016) who stated that the arteriovenous fistula (AVF) is the desired vascular access for HD patients, but its patency rate at one year is 60%. And Viecelli et al. (2017) reported that, AVF at risk of early failure (20-50%). In relation to the site of vascular access failure, the present study findings revealed that a higher rate of failure is seen at the right lower arm (radiocephalic fistula) then right upper (brachiocephalic fistula), finally, right middle arm (brachiocephalic fistula). This result matched with Khadatkar, Mahakalkar, Pradhan, and Bora (2016) who stated that radiocephalic AVF has a higher rate of complications and needs a long time for complete maturation.

In addition, Gheith (2008) reported that left radial and left brachial VA have a long duration of survival. In contrast, Al Shakarchi, Khawaja, Cassidy, Houston and Inston (2016) reported that the lower arm radiocephalic fistula (RCF) is the first vascular access recommended followed by the second option, brachiocephalic (BCF), then brachiocephalic (BBF) is the third option of fistula recommended.

In relation to time between usage of vascular access and failure in studied patient had one vascular access failure, the present study findings revealed that, the majority of the studied patients had vascular access failure after usage of access. On the other hand, less one half of the studied patients, failure occurred from one year to less than 5 years. This may be related to the absence of follow up schedule at Al-Mowasa hospital for each patient, moreover, lack of instructions given to the patients about the importance of follow up specific at the first year of access' creation for early detection of any abnormalities and early management. This result was matched by the result of Brahmhatt et al. (2016), who stated that the AVF is the desired vascular access for patients, but its patency rate at one year is 60 %.

There are many risk factors that can lead to vascular access failure such as old age, hardworking, gender, smoking, and duration of hemodialysis Mohammed et al. (2018). In addition, cardiovascular disease, hypoalbuminemia, history of HD catheter usage (Ocak et al., 2013). The result of the present study showed that there were some factors as perceived by nurses and patients that were interrelated to each other.

In relation to advanced age as one cause of vascular access failure that perceived by studied patients and nurses, the results of the present study revealed that nearly half of the studied patients and nearly three quarters of the studied nurses were agreed that advanced age considered one cause of vascular access failure. Also, this result concluded that less than half of the studied patients had vascular access failure and its related complications in the age group between 50-60 years. This finding agreed with Paulhus (2020), as they illustrated that advanced age patients were at risk factors for vascular access failure and also suggested that old age patients who started HD therapy need special interventions to maintain their vascular access patency. And Jeong et al. (2019) reported that increased age is associated with short primary patency of VA. In contrast, this result was contradicted with Jennings et al. (2011), who reported that no significant difference was observed between the age of the patient and risk of losing vascular access' primary patency.

Hormones, anatomy, and genes play a significant role in men's increased risk for vascular access failure (Spence & Pilote, 2015), besides work stress and lack of social networks and supports. Regarding gender as another factor that plays a role in vascular access failure, the results of the present study concluded that more than one half of the studied patients and the majority of the studied nurses were agreed that failure was more common in males. In addition, more than one half of the studied patients were males. This result was in the same line with Ghonemy et al. (2016a), who reported that there was a significant increase of infection in male patients rather than female patients. On the other hand, Hod et al. (2014) were contradicted with the results of the present study, they reported a higher rate of failure in female's hemodialysis patients than males.

Regarding the presence of associated diseases or manifestations related to chronic renal failure (CRF) or chronic diseases not related to (CRF), the results of the present study showed some associated diseases as hypertension, hypotension, and DM and associated manifestations as anemia and obesity were between factors that have a major role of vascular access failure as perceived by the majority of the studied patients as well as studied nurses. These findings were matched with the result of Ghaffar and Easom (2015), who stated that intradialytic hypotension is significantly associated with vascular access failure. Moreover Ghonemy et al. (2016a) and Paulhus (2020) reported that diabetes mellites is a significant risk factor for the incidence of infection.

Intradialytic complications are commonly encountered. The most associated complications during the HD session include cramps muscle, nausea and vomiting, hypotension, headache, fever, pruritus, and chills. Many of these complications are associated with hypotension. Rarely, life-threatening complications as arrhythmias and cardiovascular complications can occur (Georgianos, Sarafidis & Zoccali, 2015; Raja & Seyoum, 2020). Regarding the occurrence of complications during hemodialysis sessions, the present study findings revealed that more than three quarters of the studied patients had intradialytic hypotension which came at first of the most common complications that occur during hemodialysis session, And also this result concluded that the majority of the studied patients as well as nurses were agreed that hypertension and hypotension were common complications during hemodialysis and can be causes of vascular access failure.

On the other hand, lack of patient's lab investigations' follow up, lack of monitoring blood pressure and assessment of patients before, during, and after hemodialysis session, this may be due to nurse's ignorance how to adjust parameters of HD machine which can be another possible risk factors of vascular access failure. This finding came in line with Kanbay et al. (2020) and Chang et al. (2011) who stated that intradialytic hypotension is significantly associated with vascular access thrombosis, and Van Buren and Inrig (2016) stated that patients with intradialytic hypertension have been found to be more at risk for chronically fluid retention compared to other HD patients.

Regarding smoking, the results of the present study revealed that the majority of the studied patients as well as studied nurses were agreed that smoking can be one cause of vascular access failure. This may be related to the negative consequences and the effect of smoking on blood supply of vascular access as vasoconstrictions, increased viscosity of blood, and resistance (Leone, 2015; Toda & Okamura, 2016). This result was matched by Smith, Gohil and Chetter (2012) and Monroy-Cuadros et al. (2010), who reported that smoking is a risk factor of vascular access failure.

Patients with arteriovenous fistulas are instructed to avoid carrying heavy objects over the fistula arm. Increased awareness of patients gradually leads to overprotection and reduction of the fistula arm usage. So, HD patients can safely use their vascular access arm to lift objects weighing less than 6 lb, which encourages HD patients to increase motion and help them to preserve their fistula arm's functionality (Mo et al., 2019). In relation to hardworking as an occupation that considered one factor of vascular access failure, nearly two thirds of the studied patients were uncertain about perceived

hardworking can be one cause of vascular access failure, in contrast to the studied nurse's perception, nearly three quarters of the studied nurses were agreed that hardworking can be one cause of vascular access failure.

Other factors that play an important role in vascular access failure were the types of dialysis needles used. In relation to the perception of both studied patients and nurses, the present results denoted that more than three quarters of them were agreed that using a metal needle during cannulation procedure considered as one cause of vascular access failure. This result may be related that plastic needle is more expensive than metal needle so nursing staff use only metal needle during cannulation for effectively cost (Parisotto, Pelliccia, Bedenbender-Stoll & Gallieni, 2016). This result was matched with Marticorena and Donnelly (2016) who stated that a soft plastic needle has minimized vessel wall injury rather than a metal needle.

In relation to lack of vascular access arm exercise as one cause of vascular access failure as perceived by studied patients and nurses, the results of the present study revealed that more than two thirds of the studied patients as well as nurses were agreed that lack of vascular access arm exercise is one cause of vascular access failure. This result was matched by Tapia González et al. (2020) and Reanpang et al. (2019) who stated that arm exercise increases vascular access function, reduces morbidity and mortality in HD patients, and reduces its related complications after VA surgery. In addition, hand exercise effective in increasing the diameter of the artery and vein around the vascular access, which leads to improve the capacity and blood supply of vessels.

Concerning insertion of dialysis needle several times during cannulation procedure, the results of the present study revealed that the majority of the studied patients and more than one half of the studied nurses perceived that insertion of dialysis needle several times during cannulation procedure is one cause of vascular access failure. This result was matched by Parisotto et al. (2014) who stated that repeated punctures at the vascular access site can lead to wall defects of vessels that are filled initially by thrombi before finally healing. In addition, Brahmhatt et al. (2014) and Brahmhatt et al. (2016) who stated that, the trauma induced by repeated needle insertion during cannulation procedure for hemodialysis causes hypoxic injury which induces a series of cytokine cascades that stimulate angiogenesis, inflammation, and proliferation.

Some inappropriate practices were carried by HD patients as wearing tight clothes at vascular access sites, laying on vascular access arm, carrying heavy weight things by arm with vascular access, and measuring blood pressure from vascular access arm that contributed to vascular access failure. The results of the present study revealed that the majority of the studied patients as well as nurses considered these inappropriate practices causes of vascular access failure. This result was matched with Rushing (2010) and Kidney School (2020) who emphasized that avoidance of inappropriate practices on the vascular access arm can preserve and protect the VA and avoid complications related to VA such as thrombosis, stenosis, infection, and hemorrhage.

Concerning the lack of periodical follow-up for report any complications, the majority of both studied patients and nurses were agreed that lack of periodical follow-up for report any complications is one cause of vascular access failure. These results matched with MacRae et al. (2016a) and MacRae et al. (2016b) who stated that periodical follow-up for report any complications is very important for early detection and management of VA complications before failure occurs.

As the factors of vascular access failure are unfollowing vascular access assessment before cannulation and after decannulation, both studied patients and nurses were agreed that lack of assessment of vascular access in form of palpation (thrill) and auscultation (bruit) are causes of vascular access failure. The results of the present study denoted that the majority of the studied patients as well as nurses considered factors of vascular access failure were unfollowing aseptic technique during cannulation and decannulation procedure as, site of VA cleaned with soap and water, wearing; sterile gloves, face mask, overhead and gown by staff and hand hygiene performed by staff. These results were matched with Coventry et al. (2019) who stated that, missed cannulation and decannulation aseptic techniques at vascular access can lead to infiltration, hematoma, infection, or aneurysms formation resulting in the need for vascular access follow up, placement of central venous catheter (CVC), or permanent loss of vascular access.

Regarding instructions given to the patients for vascular access maintenance, both studied patients as well as nurses were agreed that no instruction given for patients for vascular access maintenance. These results matched with Brahmhatt et al. (2016) who concluded that vascular access failure occurs due to a lack of patient's education. In addition, Adib-

Hajbagheri et al. (2014) emphasized that self-care of patients was associated with the incidence of complications and get the attention of the nurses toward continuous patients' education and professional education, which can lead to an increase in the longevity and survival of VA.

Management of complications related to vascular access as swelling, redness around insertion site and aneurysms has an important and significant role in the maintenance of vascular access (Adib-Hajbagheri et al., 2014), the results of the present study denoted that, the majority of the studied patients and nurses were disagreed about presence of proper management of vascular access complications by nurses. This may be related to the lack of nurses' knowledge regarding how to deal with vascular access complications and the lack of instructions given to the patients about vascular access maintenance. These results matched with Canaud et al. (2019) who pointed that, lack of early detection and proper management of vascular access complications can lead to vascular access failure.

The relation between factors associated with hemodialysis patient's vascular access failure as perceived by patient and level of education, the present study findings revealed that a significant relation between level of education and overall factors that associated with HD patients VA failure. Despite more than two thirds of the studied patients had university degrees, there had a lack of knowledge about vascular access maintenance and how to deal with vascular access complications. This may be related to a lack of instructions given to the patients and a lack of follow up. This result was contradicted by Yolgösteren (2020) who observed a lower rate of vascular access patency in patients with a low level of patient's education. Therefore, the training delivered on AVF care in hemodialysis centers is required to be shaped with the educational levels of patients.

The present study findings revealed that a significant relation between the age of nurses and overall factors lead to vascular access failure, and more than one third of the studied nurses caring for hemodialysis patients, their age ranged between 20-30 years, This result matched with Ali (2018) pointed that more than two thirds of the studied nurses' age ranged from 20 to less than 30 years, while this study result disagreed with El-Moghazy (2013) who emphasized that the majority of the studied nurses were more than 30 years.

Nurses who can identify and early detect risk factors of vascular access failure properly are in the optimal position to improve patient outcomes and deal well with any critical situation. Hence, experienced, and competent nurses in the care of HD patients can reduce morbidity and mortality rates (MacRae et al., 2016a; MacRae et al., 2016b). Regarding a relation between years of experience in the HD unit and overall factors. The present study found a significant relation between years of experience in the HD unit and overall factors. The more years of experience the nurses had, the more knowledge level they achieved. This may be due to the fact that day-to-day activities enhance nurse's experience and improve their practice. On the other hand, increased years of experience associated with increased years of nurses, older nurses may find it difficult to cope with the load of work required. This result came in line with Mahmood and Mohammed (2016), who reported that the majority of the studied nurses had from one year to less than 10 years of experience in hospitals. And with Arli and Bakan (2017) and Powers, Armellino, Dolansky and Fitzpatrick (2016), who stated an increasing in compliance among nurses who have been working for a long period of time.

Appropriate management and care of vascular access are very important to hemodialysis patient's care. In addition, vascular access maintenance is a very critical issue that every nurse should be knowledgeable and focus on how to deal with any complications and factors that lead to vascular access failure (Bai, Hung & Chiou, 2014). From all the study findings, there were factors affecting vascular access maintenance related to patients as well as nurses, which supported the research questions of this study, so we must give more attention related to vascular access maintenance to prevent its failure.

V. CONCLUSION AND RECOMMENDATIONS

CONCLUSION

Based on the findings of the present study, it can be concluded that:

- The most common risk factors of vascular access failure by the majority of the studied patients and nurses in relation the most common risk factors of vascular access failure by the majority of the studied patients and nurses in relation to bio sociodemographic data, patient, vascular access, surgery, and nurses' practices factors were; insufficient

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income, followed by prolonged duration of hemodialysis, advanced age, being a male, chronic diseases, anemia, intradialytic complications, smoking, hardworking, using metal needles, lack of vascular access arm exercise, insertion of dialysis needles several times during cannulation, inappropriate practices related to vascular access maintenance, lack of periodical follow up, surgical wound complications, lack of vascular access assessment and unfollowing aseptic technique practices before, during and after cannulation and decannulation, lack of instructions given to the patients for vascular access maintenance, lack of proper management of vascular access complications were the most common identified factors.

- There was a significant relationship between the level of patient's education, age of nurses and years of nurse's experience in HD unit and overall factors of vascular access failure.

RECOMMENDATIONS

- Educational programs should be implemented to each hemodialysis patient about how to care with vascular access, the importance of follow up periodically, and risk factors of vascular access failure.
- Adequate and appropriate adherence with vascular access maintenance should be ensured for all nurses at all times.
- Regular staff meetings, training, and conferences must be conducted to discuss caring for vascular access and how to prevent vascular access failure and its related complications.
- Continuous maintenance of hemodialysis machines.
- Provider plastic needles at the dialysis unit instead of metal needles.

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