Haemodialysis catheter (Mahurkar) insertion guided with or without ultrasonography

Hassan A. Hassan[a], Mohammed A. Zaki[a], Abady A.Abdellah[b], Abdelkader A.Hashem[a]

[a]Department of Internal medicine, Faculty of Medicine, South Valley University, Qena, Egypt.

[b] Department of Anesthesiology and Intensive Care , Faculty of Medicine, South Valley University, Qena, Egypt.

Abstract:

Background: Chronic kidney disease significantly contributes to the morbidity and the mortality of critically ill patients through metabolic derangements, fluid overloaded and harmful effects of these disturbances on other failing organs..Kidney failure does not happen overnight, in the early stages of kidney disease there are few, if any, symptoms..Kidney failure is the end result of atypically gradual loss of kidney function , and the most common causes of kidney failure are diabetes and high blood pressure ,kidney failure happens when: 85-90% of kidney function is gone, GFR falls below 15mg/dl, Kidney do not work well enough to keep you alive. Vascular access is be needed into the blood stream for placing needles needed for hemodialysis included fistula, graft and catheter.

Patients and Methods: This Cross-sectional Comparative study was conducted on 100 patients of both sexes from outpatient clinic and inpatient wards of internal medicine department in Qena University hospital. Ultra-sonography through the position of IJV and femoral vein were determined using a 7, 5 MHZ linear ultrasound probe, after choosing the proper position the skin was infiltrated with 1% lidocaine and the IJV and femoral vein were located with an 18-gauge needle guided by the ultrasound probe.

Results: The complications had occurred in patients using sonar to insert hemodialysis catheter (8%) less than patients with blind technique (22%).

Conclusion: Real-time ultrasound guided catheter insertion is superior to the traditional anatomic-landmark techniques for the placement of dialysis catheters and is emerging as the new standard of care. Ultrasound-guidance improves the success, safety and speed of catheter insertion.

Keywords: Hemodialysis catheter, ultrasonography, blind technique.

Introduction:

Chronic kidney disease (CKD) is defined as the presence of kidney damage or an estimated glomerular filtration rate (eGFR) less than 60 ml/min/1.73 mt2, persisting for 3 months or more, irrespective of the cause. It is a state of progressive loss of kidney function ultimately resulting in the need for renal replacement therapy (dialysis or transplantation). (**Inker et al.,2014).**

The Clinical Practice Guidelines for Vascular Access of the National Kidney Foundation's Dialysis Outcomes Quality Initiative (KDOQI) recommends use of arteriovenous (AV) accesses (native fistulae or synthetic grafts) for hemodialysis over using the venous catheter as they provide higher blood flow rates than do venous catheters and are associated with lower rates of infection, thrombosis, septicemia, and central venous stenosis

which are common complications of the venous catheters.(**Ghonemy et al.,2016).**

Patients and methods:

This Cross-sectional Comparative study were conducted on 100 patients of both sex from outpatient clinic and inpatient wards of internal medicine department in Qena University hospital.

Study tools:

1. Full history and clinical examination.
2. CBC.
3. Kidney function test.
4. Prothrombin time and concentration.
5. Chest X ray.
6. Ultra-sonography through the position of IJV and femoral vein were determined using a 7,5 MHZ linear ultrasound probe, after choosing the proper position the skin was infiltrated with 1% lidocaine and the IJV and femoral vein were located with an 18-gauge needle guided by the ultrasound probe, when the needle appeared to be in the vessel evidenced by US and the return of venous blood into the syringe.

Statistical Analysis:

This study conducted on 100 patients divided into two groups of both sex who are candidate for haemodialysis catheter insertion by US guided or blinded technique using statistical package for social science (SPSS) version 20, and the data were tested for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests. Data were normally distributed and are presented as numbers, percentages, means, and standard deviation. A chi-square test was used to compare qualitative variables. Independent t tests were used to compare quantitave variables between two groups.

Results:

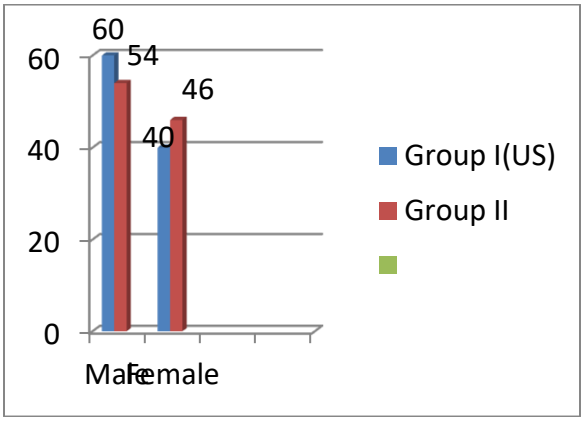
Table (1): Comparison between the two studied groups according to demographic data which (30) males with US comprise to (27) males without US and (20) females with US comprise to(23) females without US . And comparison between two groups according to age (31 – 55) years old divided into two groups with US in group(I) and without US at group(II).

	Group I(US) (n = 50)		Group II (n = 50)		Test of Sig.	p
	No.	%	No.	%		
Sex						
Male	30	60%	27	54%	χ^2= 0.367	0.545
Female	20	40%	23	46%		
Age (years)						
Min. – Max.	31.0 – 55.0		31.0 – 55.0		t= 0.486	0.628
Mean ± SD.	39.88 ± 7.12		40.56 ± 6.86			
`Median	38.0		40.0			

χ^2: Chi square test t: Student t-test

p: p value for comparing between the studied groups.

This table shows that there was insignificant differences between two groups as regard sex ,age p-value 0.545,0.628 respectively.



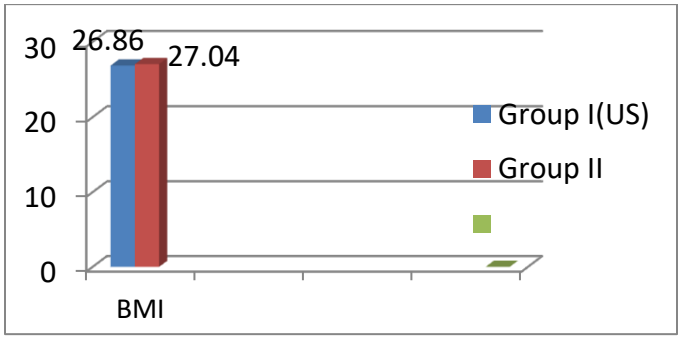
Figure(1). Comparison between the two studied groups according to sex

Table (2)Comparison between the two studied groups according to BMI (Body Mass Index),which rangefrom(25-29) at both groups (I,II) with or without using US respectively.

BMI (kg/m^2)	Group I(US) (n = 50)	Group II (n = 50)	t	p
Min. – Max.	25.0 – 29.0	25.0 – 29.0	0.794	0.429
Mean ± SD.	26.86 ± 1.20	27.04 ± 1.07		
Median	27.0	27.0		

.t: Student t-test.
p: p value for comparing between the studied groups.

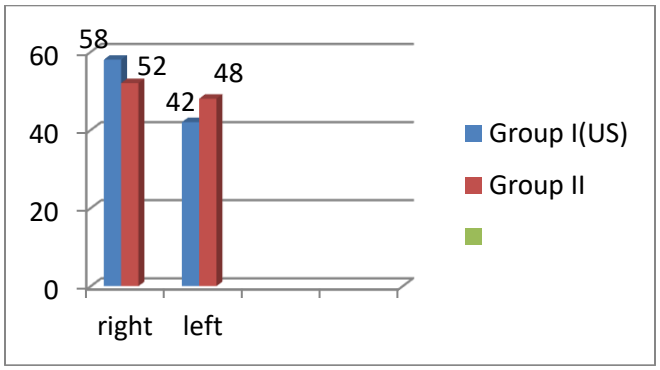
This table shows that there was insignificant differences between two groups as regard, BMI p-value 0.429.



Figure(2). Comparison between the two studied groups according to BMI.

Table3.Comparison between the two studied groups according to side which (29) patients insert catheter at right side with US and (26) patients insert catheter at right side without US comprise to (21) patients insert catheter at left side using US and(24) patients insert catheter at left without using US.

Side	Group I(US) (n = 50)		Group II (n = 50)		χ^2	p
	No.	%	No.	%		
Right	29	58 %	26	52 %	0.364	0.546
Left	21	42 %	24	48 %		



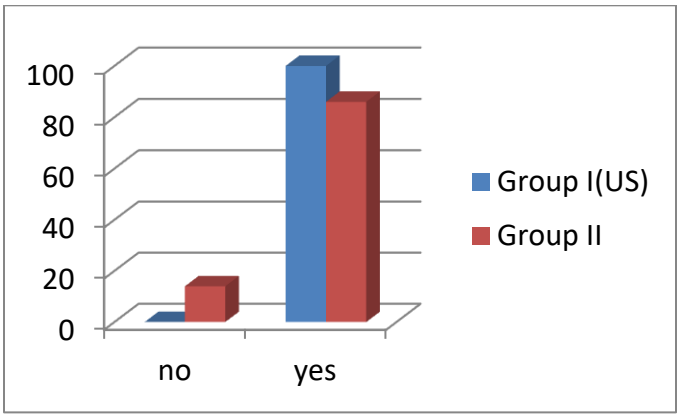
Figure(3) Comparison between the two studied groups according to side

Table (4) Comparison between the two studied groups according to successful

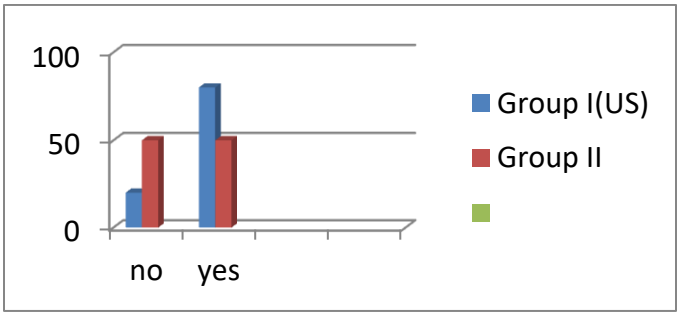
Successful Cannulations	Group I(US) (n = 50)		Group II (n = 50)		χ^2	p
	No.	%	No.	%		
No	0	0%	7	14 %	7.527*	FEp =0.012*
Yes	50	100 %	43	86 %		
First attempt cannulations						
No	10	20 %	25	50 %	9.890*	0.002*
Yes	40	80 %	25	50 %		

χ^2: Chi square test
p: p value for comparing between the studied groups
*: Statistically significant at $p \leq 0.05$
This table shows that the successful cannulations occurred in all patients in group I and in 86% of patients in group II.

As regard first attempt cannulations occurred in 80% of patients in group I and in 50% of patients in group II.



Figure(4). Comparison between the two studied groups according to successful cannulations.



Figure(5). Comparison between the two studied groups according to First attempt cannulations.

Discussion:

The creation and maintenance of a well-functioning vascular access are crucial for efficient hemodialysis therapy. The native arteriovenous (AV) fistula is widely recognized as the vascular access of first choice for most hemodialysis patients in that it has a lower frequency of complications compared with other types of vascular access **(KDOQI et al.,2015)**

In the current study we aimed to rule out the value of U/S guided vascular access insertion versus blind technique using landmark.To reduce complications of vascular access.100 patients were included then divided into two groups US guided group I and group II .In the current study we found that there was insignificant differences between two groups as regard sex ,age and BMI p-value 0.545,0.628, 0.429 respectively**.(Berns et al.,2012)**

In the current study we found that there was insignificant differences between two groups as regard reason for dialysis as most common reason in both groups was chronic glomerulonephritis p-value 0.799. In Aydin Z et al study showed that The etiologies of renal disease in the CRF group were diabetes mellitus in 263 (36.0%), hypertension in 97 (13.2%), urologic problems (stone, prostatic hyperplasia, and carcinoma, and neurogenic bladder) in 72 (9.8%), chronic glomerulonephritis in 55 (7.5%), chronic pyelonephritis in 39 (5.4%), polycystic kidney disease in 27 (3.7%), renal amyloidosis in 15 (2.1%), and unknown in 164 (22.4%) patients**(Aydin et al.,2012).**

Complication rates were also significantly lower in the ultrasound group; hematomas were observed following real time ultrasound-guided catheter insertion in 0.2% of patients as compared to 3.3% of patients following landmark-guided catheter insertion. Similarly, carotid artery puncture was reported in 1.7% of patients using realtime ultrasound as compared to 8.3% of patients with the landmark-guided technique and brachial plexus irritation was reported in 0.4% of patients with ultrasound as compared to 1.7% of patients with landmark guidance (**Denys et al.,1993).**

The access time was also significantly less in ultrasound group (15.8 vs 43.7 seconds). Overall complication rate were also markedly reduced with the use of real-time ultrasound (11.6% in landmark group as compared to 1.9% in ultrasound group).(**Lin et al.,1998).**

In a study comparing real-time ultrasound guidance to "blind" insertion following vein localization by ultrasound, Nadig et alshowedthe superiority of the

real-time ultrasound technique. There were 87 unsuccessful attempts in 37 patients when catheter insertion was attempted without real-time guidance following IJ vein localization as compared with only 10 unsuccessful attempts in 36 patients using real-time ultrasound guidance ($p<0.001$). In that study, first attempt success rate was also superior in the real-time ultrasound group as compared with ultrasound localization alone group (83% vs 35% $p<0.01$) (**Nadig et al.,1998).**

References:

Aydin Z, Gursu M, Uzun S.(2012).Placement of Hemodialysis Catheters with a Technical, Functional, and Anatomical Viewpoint, International Journal of Nephrology,Vol., Article ID 302826, 5 pages, https://doi.org/10.1155/2012/302826.

Berger JR, Hedayati SS. (**2012**).Renal replacement therapy in the elderlypopulationClin J Am SocNephro, 7(6):1039–1046. doi:10.2215/CJN.10411011.

Berns JS, Schwab SJ, Sheridan AM.(**2012**). Patient education: Hemodialysis (Beyond the Basics).CurrOpinNephrolHypertens, 22(1):1–9.

Bindroo S, Challa HJ.(**2019).** Renal Failure. [Updated 2019 Mar 5]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing, Jan-. Availablefrom:https://www.ncbi.nlm.nih.gov/books /NBK519012/.

Denys BG, Uretsky BF, Reddy RS.(**1993).** Ultrasound-assisted cannulation of the internal jugular vein: A prospective comparison to the external landmark-guided technique. Circulation, 87:1557-62.

Fraser SD, Blakeman T. (**2016).** Chronic kidney disease: identification and management in primary care. Pragmat. Obs. Res., 7:21–32. doi:10.2147/POR.S97310.

Ghonemy TA, Farag SE, SolimanSA.(**2016).**vascular access complications and risk factors in hemodialysis patients: A single center study. Alexandria Journal of Medicine, 52.67–71.

Huriaux L, Costille P, Quintard H.(**2017**). Haemodialysis catheters in the intensive care unit.AnaesthCrit Care Pain Med.,36(5):313-319.

Inker LA, Astor BC, Fox CH.**(2014).**KDOQI US commentary on the 2012 KDIGO clinical practice guideline for the evaluation and management of CKD.Am. J. Kidney Dis,63(5):713-35.

KDOQI,(2006).National Kidney Foundation.V.Aguidelines.https://www.kidney.org/sites/default/files/docs/12-50-0210_jag_dcp_guidelines va_oct 06_sectionc_ofc.pdf. Accessed 2 Oct 2015.

Lin BS, Huang TP, Tang GJ.(1**998**).Ultrasound-guided cannulation of the internal jugular vein for dialysis vascular access in uremic patients. Nephron, 78:423-8.

Nadig C, Leidig M, Schmiedeke T.**(1998).**The use of ultrasound for the placement of dialysis catheters.Nephrol Dial Transplant,13:978-81.