Haemodialysis catheter (Mahurkar) insertion guided with or without ultrasonography

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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 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 mt\textsuperscript{2}, 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.
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 with US in group(I) and without US at group(II).

<table>
<thead>
<tr>
<th>Group I (US) (n = 50)</th>
<th>Group II (n = 50)</th>
<th>Test of Sig.</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>N o.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>30</td>
<td>60%</td>
<td>27</td>
</tr>
<tr>
<td>Female</td>
<td>20</td>
<td>40%</td>
<td>23</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. – Max.</td>
<td>31.0 – 55.0</td>
<td>31.0 – 55.0</td>
<td>t = 0.48</td>
</tr>
<tr>
<td>Mean ± SD.</td>
<td>39.88 ± 7.12</td>
<td>40.56 ± 6.86</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>38.0</td>
<td>40.0</td>
<td></td>
</tr>
</tbody>
</table>

$\chi^2$: 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.

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

<table>
<thead>
<tr>
<th>BMI (kg/m²)</th>
<th>Group I (US) (n = 50)</th>
<th>Group II (n = 50)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. – Max.</td>
<td>25.0 – 29.0</td>
<td>25.0 – 29.0</td>
<td>0.794</td>
<td>0.429</td>
</tr>
<tr>
<td>Mean ± SD.</td>
<td>26.86 ± 1.20</td>
<td>27.04 ± 1.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>27.0</td>
<td>27.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

: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.

Table (3) 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.

<table>
<thead>
<tr>
<th>Side</th>
<th>Group I (US) (n = 50)</th>
<th>Group II (n = 50)</th>
<th>χ²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>29 58 %</td>
<td>26 52 %</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Left</td>
<td>21 42 %</td>
<td>24 48 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Successful Cannulations</th>
<th>Group I (US) (n = 50)</th>
<th>Group II (n = 50)</th>
<th>χ²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>0 0 %</td>
<td>7 14 %</td>
<td>7.52</td>
<td>0.00</td>
</tr>
<tr>
<td>Yes</td>
<td>50 100 %</td>
<td>43 86 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First attempt cannulations

| Yes            | 40 80 % | 25 50 % | 9.89 0.00 |
| No            | 10 20 % | 25 50 % | 0.00 2.00 |
**Hassan et al (2020)**

\( \chi^2 \): Chi square test

p: p value for comparing between the studied groups

*: Statistically significant at p ≤ 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 US 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 al showed the 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:


