

Ultrasound-guided cannulation in placement of Hemodialysis Access Catheters in Predialysis Patients

Murat Yildar¹, Orcun Gurbuz², Gencehan Kumtepe², Murat Basbug¹, Omer Toprak³

Abstract

Aim: Ultrasound (USG)-guided hemodialysis catheter placement is known to be superior to and more reliable than catheter insertion guided by anatomical landmarks. USG is used for vascular mapping (VM) before catheter placement, or real time. This study investigated the effect on outcomes of USG techniques used in patients with hemodialysis catheters inserted through the internal jugular vein (IJV) due to emergency hemodialysis indication while being monitored for Predialysis Renal Failure (PRF).

Material and Methods: Fifty-nine patients with PRF undergoing USG-guided hemodialysis catheter placement between January 2012 and May 2014 at the Balıkesir University Health Practice and Research Hospital were evaluated retrospectively.

Results: Twenty-eight patients were male and 31 female. The right IJV was used in 57 patients and the left IJV in two. Success rate at first attempt in real time USG group was 91.3% (21/23), compared to 91.6% (34/36) in the VM group. Average number of puncture was similar (1.08 ± 0.291 vs. 1.16 ± 0.56). No complications occurred in either group.

Discussion: Use of USG in real time and for VM in patients with PRF gives similar results in terms of success and complication rates. We therefore recommend that USG only for vascular mapping be used solely in these patients in order to avoid time loss and increased costs.

Keywords: Ultrasound (USG) guided hemodialysis catheter placement

Introduction

The treatment modality of choice in end stage renal disease is kidney transplantation [1]. However, due to low donor numbers or graft dysfunction, patients may also require dialysis therapy [1, 2]. Recent years have seen an increase in centers providing medical therapy for patients with predialysis renal failure in order to delay hemodialysis [3]. One of the major problems for these patients is the requirement for urgent hemodialysis.

Vascular access with appropriate flow in the upper extremity, such as arteriovenous fistulae and grafts, are preferred for hemodialysis [4]. However, these have to mature in order to be capable of use. Vascular access in patients requiring hemodialysis can be temporarily established with a hemodialysis catheter inserted in the

jugular, subclavian or femoral veins [5]. Potentially life-threatening complications may occur during hemodialysis catheter placement. Thrombosis associated with previous procedures, stenosis or abnormal vein position and congenital vein agenesis can all complicate the procedure [6, 7].

Ultrasound (USG) -guided catheter placement is recommended in order to minimize complications and increase success rates [7]. Several studies to date have compared the effectiveness of different forms of USG-guided catheter insertion for hemodialysis in patients with chronic renal failure (CRF) [6-8]. This study was planned to determine the difference between for pre-catheterization vascular mapping and real time use of USG

Received: 5 July 2014, **Revised** 10 July 2014, **Accepted** 14 July 2014, **Available Online** 30 July 2014

¹Balıkesir University Medical School, Department of General Surgery, Balıkesir, Turkey

²Balıkesir University Medical School, Department of Cardiovascular Surgery, Balıkesir, Turkey

³Balıkesir University Medical School, Department of Internal medicine, Balıkesir, Turkey

*Corresponding Author: Murat Yildar muratyildar@hotmail.com

Material and methods

Methods: Fifty-nine patients receiving hemodialysis catheter through the jugular vein using USG due to emergency hemodialysis indication during monitoring for PRF at the Balikesir University Health Practice and Research Hospital between January 2012 and May 2014 were included in this retrospective study. Computing system and patient medical files were reviewed, and patients were compared in terms of age, sex, body mass index (BMI), urea values, creatinine values and puncture number depending of method of USG use.

Operative technique: Catheter placed was performed by two surgeons, one using USG for pre-catheterization vascular mapping and the other in real time. Both surgeons had 5-years' experience of USG-guided catheter placement. Both surgeons performed USG-guided catheter insertion more than a hundred. The first surgeon used USG (ProSound Alpha 5 Aloka, Japan) to determine jugular vein anatomy before the catheterization to indicate the puncture site (pre- catheterization USG group). The second surgeon used USG both to assess vascular structures before the catheterization and in real time during it (real time USG group). On real time USG management, following local anesthesia with Prilokain hidroklorür (Citanest %2, Astra-Zenecca, Türkiye), in contrast to the other group, the USG probe was covered with a sterile sheath and inserted perpendicularly with the left hand into the vessels (Fig. 1). A 45 degree angle was established with the right hand and venous puncture was performed in real time. A 12.5 F hemodialysis catheter was inserted with the Seldinger technique. Patients were monitored using chest X-ray after the procedure in terms of catheter location and complications such as pneumothorax and hemothorax

Statistical Methods

Data are presented as the means and standard deviation, median, and percentage (range). The t test was used to compare normally distributed numerical data between the groups, and the Mann–Whitney U-test was used for non-normally distributed data. In all analyses, $P <$

0.05 was taken to indicate statistical significance. Statistical analyses were performed using SPSS software (Statistical Package for the Social Sciences, version 21.0; SPSS Inc., Chicago, IL, USA).

Results

Twenty-eight of the 59 patients were men and 31 women. The Median age was 66 (range 26-86) years. Catheter insertion was performed by the first operator using pre- catheterization USG in 36 patients and by the second operator using real time USG in 23 patients. There was no significant difference between the groups in terms of age or gender.

Characteristics/Outcomes	VM (n=36)	RT (n=23)	P*
Age (years)	61.7±12.5	63.7±13.6	0,423
Sex (M/F)	19/17	9/14	
Mean BMI (kg/m ²)	26.4 ± 6,8	29.7± 7.9	0,131
Creatinine	6.9±3,5	5.55±1.8	0,227
Urea	180.1±73,7	161.2±77.2	0,501
Success rate at first attempt	34/36 (91.6)	21/23(%91.3)	0,561
Average number of puncture	1.16±0.6	1.08±0.3	0,078

Data are expressed as Mean±SEM or number (percentage).
* P values <.05 were considered statistically significant

Mean BMI was 26.38 ± 6.82 in the pre-catheterization USG group and $29,65 \pm 7,90$ in the real time group. Length of monitoring due to PRF was 546 days in the pre-catheterization USG group and 930 days in the real time USG group. No patient had a previous history of central venous catheter insertion. Urea and creatinine levels were similar in both groups. Patient groups' characteristics are shown in Table 1. Right internal jugular vein (IJV) was used in all pre-catheterization USG patients. Catheter was employed at first attempt in 34 patients. The first attempt success rate was 91.6%. The right IJV was used in 21 patients in the real time USG group and the left IJV in two. Catheter was inserted at the first attempt in 21 of these. The first attempt success rate was 91.3%. The difference between the groups was no significant. No catheter insertion failure occurred in any patient in either group. No complications were observed. Success rate at first attempt and average number of puncture are shown in Table 1.

Discussion

This study showed high success rates for USG-guided catheter insertion in patients with PRF. There was no difference in terms of success rates between real time or pre-catheterization USG.



Figure 1: Cannulation of the right internal jugular vein with using real time USG

Hemodialysis catheters are generally easily inserted using the anatomical landmark technique. However, puncture may need to be repeated due to reasons such as obesity, anatomical variations, previous catheterization procedures and inability to position the patient [7]. This not only prolongs the procedure, but increases complication rates and reduces success rates.

USG-guided IJV catheter placement is reported to have success rates close to 100% and to prevent carotid puncture [2, 6]. Success rates rise and complication levels also decrease in patients with CRF when catheter placement is performed using USG. Studies using USG in real time in hemodialysis catheter insertion have recorded first entry success rates of 56-85% and average number of needle puncture ranged between 1.17 and 1.75 [2, 8]. USG has been shown to be superior to the anatomical landmark technique in these studies. As distinct from other studies,

we compared real time USG use with USG for vascular mapping. Similar success rates were observed in both forms of USG use. No carotid puncture was performed in any patient in either group, and no complications developed.

Real time USG use requires that the probe be covered with a sterile sheath. Some experts regard this as involving time and expense costs, and so perform vascular mapping first and real time USG if this is unsuccessful. Patients requiring hemodialysis catheter placement during monitoring for PRF did not receive previously a central venous catheter, and this had a positive effect on the results of USG use solely for pre-catheterization vascular mapping. No significant difference was observed in terms of success and complications between real time USG and vascular mapping use in this patient group. We therefore think that pre-catheterization vascular mapping may be a good alternative to real time USG in order to prevent costs and time loss in patients with PRF

Conflict of Interest

The authors declared that they had no conflicts of interest.

Acknowledgments

We thank Prof. Said Bodur for the statistical analysis of the data.

References

- [1] Garcia GG, Harden P, Chapman J, For The World Kidney Day Steering C. The Global role of kidney transplantation. *Journal of nephrology*. 2012;1(2):69-76.
- [2] Muramatsu M, Gonzalez HD, Cacciola R, Aikawa A, Yaqoob MM, Puliatti C. ABO incompatible renal transplants: Good or bad? *World journal of transplantation*. 2014;4(1):18-29.
- [3] Wu IW, Wang SY, Hsu KH, Lee CC, Sun CY, Tsai CJ, et al. Multidisciplinary predialysis education decreases the incidence of dialysis and reduces mortality--a controlled cohort study based on the NKF/DOQI guidelines. *Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association*. 2009;24(11):3426-33.
- [4] Rose DA, Sonaike E, Hughes K. Hemodialysis access. *The Surgical clinics of North America*. 2013;93(4):997-1012, x.
- [5] Robson JP, Jr. A review of hemodialysis vascular access devices: improving client outcomes through evidence-based practice. *Journal of infusion nursing : the official publication of the Infusion Nurses Society*. 2013;36(6):404-10.

- [6] Farrell J, Gellens M. Ultrasound-guided cannulation versus the landmark-guided technique for acute haemodialysis access. *Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association*. 1997;12(6):1234-7.
- [7] Tammam TF, El-Shafey EM, Tammam HF. Ultrasound-guided internal jugular vein access: comparison between short axis and long axis techniques. *Saudi journal of kidney diseases and transplantation : an official publication of the Saudi Center for Organ Transplantation, Saudi Arabia*. 2013;24(4):707-13.
- [8] Akoglu H, Piskinpasa S, Yenigun EC, Ozturk R, Dede F, Odabas AR. Real-time ultrasound guided placement of temporary internal jugular vein catheters: assessment of technical success and complication rates in nephrology practice. *Nephrology*. 2012;17(7):603-6.