Study of the quality of vascular access care among hemodialysis patients

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Abstract
Aims: Given the lack of study in the field of vascular access care for hemodialysis patients and its important role in longevity of vascular access, this study aimed to assess the quality of vascular access care among hemodialysis patients.

Methods: This cross-sectional study was conducted on 85 patients undergoing hemodialysis in Ali-Asghar hospital of Isfahan in the second half of 2010. Data were collected using a demographic questionnaire and a checklist related to vascular access care techniques, and analyzed by t-test and descriptive statistics and SPSS17 software.

Results: A total of 36 females and 49 males with an average of 46.44 months of hemodialysis were studied, among whom 25 patients underwent hemodialysis through subclavian catheters and 60 ones by arteriovenous fistula. The overall quality of care for vascular access site was moderate in 41.2% of cases. Selecting an inappropriately high speed for the apparatus at the beginning of dialysis, incomplete priming of the filter and the tubes, keeping open the outlet of arterial catheter while disconnecting the patient from the apparatus and needling of an aneurysm were the most common improper actions.

Conclusions: The overall quality of care for vascular access site has been in moderate level. Therefore, reinforcement of nursing continuing education programs and development of standard vascular access care protocols are recommended to improve care techniques.

Keywords: Hemodialysis; Vascular access site; Quality of care; Arteriovenous fistula

Introduction
Hemodialysis is the most common treatment for renal failure[1,2]. Chronic hemodialysis treatment requires vascular access, which can be provided by central venous catheter, arteriovenous fistula or arteriovenous graft inserted between arterial and venous blood vessels [1]. Central venous catheters are usually used for patients who need short-term dialysis; however, since central venous catheters are accompanied with more incidence of infection, occlusion, thrombosis and vein stenosis, arteriovenous fistula or graft are proper to be applied for long-term use [3].

Using different methods of vascular access is highly dependent on patient's condition. A report indicates that using rate of temporary and permanent vascular access is 93% and 7% respectively at the beginning of hemodialysis. Yet, temporary methods are usually replaced with permanent approaches during the treatment process [4]. Arteriovenous fistula is considered as the most appropriate and frequent method of vascular access in chronic hemodialysis in terms of function, duration and lower rates of complications [2,3]. In patients with vessels unsuitable for an arteriovenous fistula, arteriovenous grafts or central venous catheters are used [2,3]. Each of vascular access procedures are associated with different complications, and, therefore, require special measures to augment vascular access maintenance [5].

Vascular access complications account for 16% to 25% of hospitalizations among patients undergoing hemodialysis [6]. The incidence of aneurysm formation in arteriovenous fistula has been reported approximately 5 to 6 percent in an investigation. According to Hong-yee, improper cannulation and repeated punctures at clustered sites can weaken the vessel’s wall, causing aneurysm formation and increasing the possibility of rupture and hemorrhage [7]. Vanloon et al have also announced that repeated cannulation in the exact same puncture site can result in hematoma, thrombosis, infection and aneurysm formation, and subsequently increase the frequency of hospitalization and access failure rate [8]. Therefore, it is recommended that cannulation not be done along with any type of venous aneurysm [9].

Hooland et al believe that a successful hemodialysis, good function of vascular access and its maintenance require a multidisciplinary approach where nephrologists, access surgeons, dialysis...
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nurses and patients work together in close collaboration. However, Hooland has put great emphasis on vascular access investigation through bedside duplex ultrasonography as the best method for optimizing vascular access care [10] and has forgotten the role of appropriate nursing in maintaining the quality and efficiency of vascular access care. Bachleda et al has studied the effective factors in prevention and treatment of arteriovenous graft infection. Alexander et al have also investigated physicians' as well as healthcare providers' behavior with hemodialysis patients. Nonetheless, caregivers' treatment approach with vascular access site has still been ignored [11,12]. In one of his rare investigations, Vanloon addressed to the predictors of unsuccessful cannulation and consequent associated complications in patients with arteriovenous fistula. He reported that improvement in catheter insertion technique can affect arteriovenous fistula functioning and durability [8]. Likewise, previous studies have emphasized on the existence of a significant correlation between durability, efficiency and complications of fistula with history of diabetes, hypertension, using central venous catheters [4], age and sex [6]. However, at the beginning of the present study, there was no, or at least available, published study regarding the care quality and caregivers' treatment manner with vascular access site. Therefore, considering the role of care quality in durability and function of the vascular access site, and the risks resulting from disregarding it, and also lack of enough study in this regard, the present study was conducted to evaluate the quality of care for vascular access site among patients undergoing chronic hemodialysis to provide appropriate strategies toward improving vascular access care quality and reducing associated complications.

Methods
This cross-sectional study was performed on 85 patients with ESRD who referred to Ali-Asghar Hemodialysis Center of Isfahan for chronic hemodialysis. Sampling was done consecutively in the second half of 2010. The data were collected through observation and using a checklist related to care techniques and included two parts; the first part contained 12 questions associated to demographic information such as age, sex, education, underlying diseases, dialysis duration, the number of dialysis per week, previous vascular access, current vascular access, duration of current vascular access, exercising the limbs with fistula and patient's self-care manner. The second part, which was designed after an extensive literature review, consisted of 14 items (about catheter insertion techniques and connecting patients to the machine) such as observing aseptic technique, wearing gloves, wearing mask, heparin bolus injection, appropriate priming, closing the venous catheter cap while connecting patient to the machine, adjusting correct dose of heparin based on physician's prescription, closing one line while washing the other line, closing the arterial catheter cap while disconnecting patient from the machine, using a sterile dressing on catheter site, blood flow rate at the beginning of hemodialysis, the distance between needle entrance site and fistula, correct needling, and needling of the aneurysm. Four of the mentioned items were related to arteriovenous fistula (blood flow rate at the beginning of hemodialysis, the distance between needle entrance site and fistula, correct needling, and needling of the aneurysm), and three items were associated with central venous catheter (closing one line while washing the other line, closing the arterial catheter cap while disconnecting patient from the machine, and sterile dressing on the catheter site), and the first seven items were common in both groups. Observing aseptic technique was assessed by complete disinfection of the access site before and after catheter insertion and also creating a sterile environment under the central venous catheter (before and after any line opening). The distance between needle entrance site and fistula was considered to be appropriate if needles were entered 3-5 cm away from fistula [7].
The care quality score was determined based on second part of the checklist. To calculate the quality, zero score was given for non-adherent and score 1 to adherent items. The score range was 0 to 10 for central venous catheter and 0 to 11 for arteriovenous fistula. The quality of care was categorized as "optimal", "moderate" and "undesirable". Obtaining 0-50 percent of score was considered as undesirable quality of care, 51-75% as moderate, and 76-100% as optimal care quality. Content validity of the checklist was confirmed by 10 faculty members of School of Nursing and 6 nurses and physicians with experience in hemodialysis units. Checklist reliability was also proven through inter-raters reliability; for this purpose, checklist was completed for three patients, and for each patient by three nurses (including the second author of the article and two other nurses), and the results were compared with each other, which were similar for all the three cases. Data were analyzed using t-tests and descriptive statistics by SPSS11.5 software. This study was approved by Medical Research Ethics Committee of Kashan University of Medical Sciences as well as hospital officials. All the patients and nurses participated in the present study were given the informed consent form.

Results
In total, 85 patients undergoing chronic hemodialysis with age range of 55.16±14.43 years, including 36 females and 49 males, were studied. The mean hemodialysis duration was 46.44±44.94 months (3.87±3.74 years) in the study subjects, and the average number of dialysis was 2.63±0.48 times per week. 54 patients (63.5%) underwent hemodialysis three times and 31 subjects (36.5 %) two times a week. in total, 25 cases underwent hemodialysis by subclavian catheter and 60 ones by arteriovenous fistula. The average duration of hemodialysis was 26.64±31.41 months (2.22±2.61 years) in patients with catheter and 54.70±47.31 months (4.58±3.94 years) in those with fistula. Eight patients with subclavian catheter (32%) had a history of receiving two-week antibiotic therapy for catheter infection during the last 6 months. In regard to self care of vascular access, 28 cases (46.7%) did regular exercises of the concerned extremity, and only 15 patients (25%) observed the recommendations for not to lay on the limb with fistula. None of the patients allowed blood pressure taking from the hand with fistula.

Table 1 indicates that the overall quality of vascular access care was in moderate level in more than 51.8 percent, and only four of the cases could obtain full score of the care quality. Furthermore, patients with arterial venous fistula obtained higher percentage of care quality score compared to those with central venous catheters, although t-test showed no significant difference (P>0.05).
Moreover, Table 2 demonstrates that in more than 31.8% of cases, the staff did not wear masks while catheter insertion, and aseptic technique was not observed in vascular access care by 8.2%. The rate of blood pump was also more than 150 ml/min at the beginning of hemodialysis in almost 70% of cases.

**Discussion**

This study aimed to evaluate the quality of care in vascular access site among patients undergoing hemodialysis. The results revealed that total score of care quality was in moderate level for vascular access site in more than 89.4% of the cases. However, the quality of care was in an undesirable level in approximately one-eighth of cases. These findings indicate the need for strengthening measures to improve the quality of care. Care quality had also been shown to be better in patients with AVF than those with central venous catheter. This might be due to more complex process of connecting and disconnecting patients from hemodialysis device in those with central venous catheter.

According to the researchers' information, the

<table>
<thead>
<tr>
<th>Table 2: Vascular access and care techniques</th>
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<td>Result</td>
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<tr>
<td>N (%)</td>
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<td>---------</td>
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<tr>
<td>Aseptic technique</td>
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<td>Wearing gloves</td>
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<td>Wearing mask</td>
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<td>Heparin bolus injection</td>
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<td>Appropriate priming</td>
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<td>Closing the venous catheter cap while connecting patient to the machine</td>
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<td>Adjusting correct dose of heparin based on the physician's order</td>
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<td>Closing one line while washing the other line*</td>
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<td>Closing the arterial catheter cap while disconnecting patient from the machine*</td>
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<td>Sterile dressing on the catheter site*</td>
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<td>Correct needle insertion ♦</td>
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<td>The rate of blood flow at the beginning of hemodialysis &lt;150 ♦</td>
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<td>Needling of the aneurysm ♦</td>
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<td>The distance between needle entrance site and the fistula ♦</td>
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* for central venous catheter

♦ for arteriovenous fistula
present study is the first Iranian survey and one of the few investigations aimed to evaluate the quality of care in vascular access site among hemodialysis patients. Despite the vital importance of vascular access route preservation in patients undergoing chronic hemodialysis, and decrease in dialysis adequacy, and patients' exposure to life threatening situation in cases of inadequate or failed vascular access [13,14], the quality of care has still been given little attention for vascular access site, and no standard measure has been designed to evaluate it. Yet studies have shown that almost 50% of hemodialysis patients' readmissions have been owing to problems at vascular access site [15].

In the present study, the frequency of vascular access site infection was clearly more in patients with central venous catheters than other cases, so as almost 42% of the mentioned group had a history of taking antibiotics during the last six months to treat the infections. In a study by Ghane, the highest and lowest infection rate were found in hemodialysis patients with central venous catheters and arteriovenous fistula respectively [4], although the difference was not statistically significant (p > 0.05); this may be probably due to small sample size in the study groups. However, higher infection rate for patients with central venous catheter can be attributed to the lower quality of care in this group.

In more than one-third of cases observed in the present study, at least one of the needles was inserted into the aneurysm. According to a report by Vanloon, repeated cannulation in a small circumscribed area may cause damage to vessels and subsequent development of stenoses and aneurysm, and needle insertion in aneurysm may followed by vessel rapture [8]. Therefore, it seems that required attention has not been paid to the process of catheter insertion. In one of the few studies on quality of care for vascular access site done by Vanholder, it has been exhibited that although the exigency of regular vascular access site monitoring has been pointed, it is highly emphasized on medical measures such as regular Doppler ultrasonography to monitor blood circulation, and taking some medications to prevent thrombosis [14], and catheter insertion technique and nursing care of vascular access site has been ignored. Furthermore, although Hooland has mentioned the necessity of surgeons, physicians, nurses and patients collaboration in maintaining the efficacy of vascular access, he has only numerated duplex ultrasononography as the main measure for monitoring quality of care for vascular access site, while disregarding the care quality itself, catheter insertion technique, and patients' self care processes [10].

In a study on the patency rate and complications of vascular access grafts for hemodialysis, Salimi has focused on training dialysis staff in terms of vascular access care as the basic strategy to reduce complications and increase vascular access efficiency [16]. This indicates the significance of the care quality and its impact on creation or prevention of complications.

The present study demonstrated that although all the patients have been aware of the necessity of avoiding injections, blood sampling and blood pressure monitoring from the limb with fistula and have observed these restrictions, they have not followed other self-care techniques well.

This finding underlines the importance of patient education about self-care of vascular access site as well. On the other hand, moderate or undesirable quality of care in more than 51% of the cases can illustrate the need for retraining hemodialysis staff and developing a standard protocol in order to provide better care for vascular access site.

**Conclusion**

The present study was conducted with the aim of evaluating the quality of care in vascular access site among patients undergoing chronic hemodialysis in a large hemodialysis center, and showed moderate level of care quality in the study participants. Therefore, it draws officials’ attention to the exigency of continuing nursing education and developing a standard protocol for vascular access care in order to improve care techniques. This issue contributes to longevity of vascular access site and improves quality of patients' life and
92 Evaluation of the quality of vascular access care… reduces expenses of vascular re-access processes.

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References