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Original Article

Catheter Infection Among Hemodialysis Patients: A Report From Fars Province, Iran

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Abstract

Background: Catheter-related bloodstream infection (CRBI) is one of the main causes of mortality and morbidity among hemodialysis patients. Thus, documenting its prevalence and risk factors in each center will help control them and improve patients' prognosis.
Methods: This one-year cross-sectional study was performed in the educational hospitals of Shiraz University of Medical Sciences. Patients were selected using the census method. The included cases aged more than 18 years and had hemodialysis using a double lumen catheter. Finally, data were analyzed by SPSS analytical software.
Results: In general, 345 patients with a mean age of 57.90±16.59 were included (192 men and 153 women) in this study. In addition, 138 (40%) patients had the elementary education and 127 (36.8%) study participants were housekeepers. Further, the subclavian vein was the most used site for the catheter (228 cases, 66.10%). Further, 187 (54.20%) cases had CRBI of whom, 181 patients had a previous history of CRBI. Furthermore, fever and chills at the time of hemodialysis were the most prevalent manifestations. Eventually, patients' age, job, level of education, location of the catheter, previous history of CRBI, hand washing (patient and health-care personnel), use of gloves (health-care personnel), oral administration of antibiotics, use of topical antibiotic ointment, and the pattern of dressing change had a significant impact on the risk of CRBI ($P<0.001$).
Conclusions: The prevalence of CRBI is still high. Accordingly, it is needed that interventions be conducted to reduce modifiable risk factors for this issue and prevent hemodialysis patients' morbidity and mortality.
Keywords: Catheter-related infections, End-stage renal disease, Hemodialysis

Background

End-stage renal disease (ESRD) is currently a major global public health issue, particularly among old age populations (1,2). Available data shows that the incidence of ESRD has an increasing trend in both developing and developed regions of the world (1).

In addition, ESRD patients should undergo regular hemodialysis through a vascular access. Three main types of vascular access are now available including central venous catheters, synthetic arteriovenous grafts, and arteriovenous fistulas (3).

Central venous catheters are not always the best choice although they are yet used as frequent vascular access for hemodialysis (4). The complications of these catheters can be categorized into infectious and non-infectious groups (4). Catheter dysfunction, central vein stenosis, and catheter-related thrombi are among the non-infectious complications of hemodialysis catheters (4). Further, catheter-related bloodstream infection (CRBI) is the main infectious complication of hemodialysis catheters. The term CRBI is used to describe bacteremia that originate from an intravenous catheter (5). CRBI, as the most frequent complication of central venous catheters, is known as a major cause of nosocomial bacteremia as well (4-6). It is evident that the use of central venous catheters increases all causes of mortality among hemodialysis patients. This is particularly due to CRBI (7). Previous research has shown that patients with ESRD with a tunneled central venous catheter for hemodialysis are at about 15-fold increased risk of CRBI in comparison with those who use arterio-venous fistula for this purpose (6).

The above-mentioned facts emphasize the importance of planning and policy-making regarding prevention, timely diagnosis, and treatment of catheter-related complications, specifically CRBI in order to reduce the burden of these issues for patients and the health-care system. To this end, it is essential to collect local data on the prevalence, risk factors, and outcomes of hemodialysis patients with catheter-related complications, which was the aim of the current research.

Methods

This cross-sectional study was conducted in the educational hospitals of Shiraz University of Medical Sciences located in Shiraz and Marvdasht, Fars province, Iran during 2016-2017. This research was approved by

the Research Deputy of Shiraz University of Medical Sciences and its Ethics Committee. Moreover, informed consent forms were obtained from study participants.

Additionally, the included patients were selected using the census method. All selected patients aged more than 18 years old and were under hemodialysis using a double-lumen catheter due to ESRD. On the other hand, cases that suffered from acute kidney injury, patients on peritoneal dialysis, and those undergoing double-lumen insertions for a reason other than hemodialysis were excluded from the study.

Similarly, a data collection form was used to document patients' demographic features (i.e., age, gender, level of education, and occupation) and information related to hemodialysis catheters (i.e., the location of the catheter and the total duration of its use, along with the interval between hemodialysis sessions and the duration of each session). In addition, other data included health-care personnel hand hygiene (i.e., the use of gloves, hand washing, use of disinfectants and betadine, and the use of antibiotics), patients' clinical findings, and any previous history of double-lumen infections. A medical intern was responsible for data gathering. In this study, the catheter infection was defined as the presence of obvious clinical signs of infection or positive blood cultures.

Data analysis was performed using SPSS analytical software (version 20, SPSS Inc., Chicago, Ill., USA). The Chi-square test and descriptive statistics including mean and standard deviations, and percentages were used to analyze data. A $P<0.05$ as considered statistically significant.

Results

Overall, 345 patients were included in this study, including 192 male (55.70%) and 153 female patients (44.30%). Further, the mean ± standard deviation (SD) of patients' age was 57.90 ± 16.59. Furthermore, most patients had elementary education (138 cases; 40.00 %) and the most studied population included housekeepers (127 patients, 36.8%), the details of which are provided in Table 1.

Moreover, most included patients had a double-lumen catheter placed in the subclavian vein (228 cases, 66.10%). Other patients had a tunnel catheter (87 cases, 25.20%), and catheters were placed in femoral (11 cases, 3.20%) and internal jugular (19 cases, 5.50%) veins.

Among 345 included patients, 158 cases (45.80%) had no evidence of double-lumen infections. In contrast, 187 (54.20%) of them had infected hemodialysis catheters. In the latter group, 181 cases had a previous history of double-lumen infection.

Based on the results, fever and chills at the time of hemodialysis were the most prevalent clinical manifestations among patients with double-lumen infection. This finding was present in 99 (28.70%) patients with catheter infections. Likewise, erythema and tenderness at the site of catheter insertion were the other prevalent clinical findings (Table 2).

Our results showed that health-care personnel used hand washing at the time of hemodialysis for 175 (50.70%) of patients while using gloves for 200 (58%) ones. Additionally, 153 (44.30%) patients were on at least one oral antibiotic agent, 134 (38%) cases used a topical antibiotic, and topical betadine was used for 30 (8.7%) patients at the site of catheter insertion. According to our findings, 321 studied patients (93.04%) changed the dressing of the site of the double-lumen after hemodialysis

Table 1. Study Case Information Including Their Age, Data, Level of Education, and Occupation

		Number of Patients (%)
Age group (y)	<30	32 (9.3)
	30-40	14 (4.1)
	40-50	44 (12.8)
	50-60	56 (16.2)
	60-70	105 (30.4)
	>70	94 (27.2)
Gender	Male	192 (55.7)
	Female	153 (44.3)
Level of education	Illiterate	88 (25.5)
	Elementary	138 (40)
	Diploma	71 (20.6)
	University	48 (13.8)
Occupation	Housekeeper	127 (36.8)
	Employee	24 (7)
	Collegian	6 (1.7)
	Unemployed	36 (10.4)
	Self-employment	96 (27.9)
	Others	56 (16.2)

Table 2. Prevalence of Clinical Manifestations Among Cases With Double-lumen Infections

Clinical Finding	Number of Patients (%)
Skin erythema	68 (19.8)
Skin induration	2 (0.6)
Skin tenderness	15 (4.3)
Pain	1 (0.3)
Purulent drainage	2 (0.6)
Fever and chills	99 (28.7)

(Table 3).

Our study revealed no statistically significant correlation between patients' gender, duration of catheter use, previous use of hemodialysis catheter, the interval between hemodialysis sessions, use of a topical betadine solution, and the risk of a catheter-related infection ($P>0.05$). However, a correlation was found between the prevalence of catheter-related infection and the hemodialysis patients' age group. According to the obtained data, patients within the age range of 30-40 years old were at a higher risk of a catheter-related infection ($P<0.001$). In addition, patients' job, level of education, location of the catheter (more risk for subclavian catheters), previous history of catheter-related infection, hand washing (patient and health-care personnel), use of gloves (health-care personnel), oral administration of antibiotics, use of topical antibiotic ointment, and the pattern of changing catheter dressing had a statistically significant impact on the risk of the catheter-related infection ($P<0.001$).

Discussion

This cross-sectional study aimed to provide local data on the prevalence of catheter-related infection and contributing factors. Our study demonstrated that more than half of the studied population had evidence for catheter-related infection, and various factors significantly influenced its occurrence (Table 4).

It has been shown that the highest all-cause mortality rate occurs within the first year of treatment in patients undergoing hemodialysis, particularly during the first 120 days after hemodialysis initiation (8). The use of central venous catheters is one of the major causes of these mortalities. Accordingly, available guidelines recommend the use of arteriovenous fistulas in more than 65% of patients with ESRD while on routine dialysis. Nonetheless, it is believed that the proportion of cases using dialysis catheters as vascular access should be less than 10% (7,9,10). However, the use of dialysis catheters remains popular and catheter complications, particularly CRBIs, affect the health-care system and patients (7,11,12).

Based on the findings, no significant association was observed between patients' gender and the incidence of catheter-related infection, which is in line with the results of Coker et al, demonstrating that although female gender is an independent predictor of tunneled hemodialysis catheter dysfunction, it does not increase the risk of catheter infection (13).

Another factor that had a significant influence on the risk of catheter-related infection was the previous history of catheter infection and hospitalization. Similarly, Fram et al performed a case-control study on patients undergoing hemodialysis in order to assess risk factors for developing bloodstream infections. They found that previous hospitalization acts as an independent risk factor for catheter-related infection (14).

Table 3. Data Related to the Use of the Catheter Among Hemodialysis Patients

		Number of Patients (%)
Interval between changing dressing of the catheter	After each hemodialysis	321 (93%)
	Daily	7 (2%)
	Every 2 weeks	3 (0.9%)
	Every 3 weeks	11 (3.2%)
	Every 4 weeks	3 (0.9%)
Previous use of double-lumen catheter	Yes	231 (67%)
	No	114 (33%)
Duration of catheter use (mon)	≤ 1	41 (11.9%)
	2–3	76 (22%)
	3–4	35 (10.1%)
	4–5	21 (6.1%)
	5–6	14 (4.1%)
	6–7	4 (1.2%)
	7–8	17 (4.9%)
	8– 9	1 (0.3%)
	9 –10	1 (0.3%)
	10–11	0 (0%)
	11–12	73 (21.3%)
	>12	62 (18%)
Interval between hemodialysis sessions	Daily	2 (0.6%)
	One time/week	19 (5.5%)
	Two times/week	125 (36.2%)
	Three times/week	196 (56.8%)
	Four times/week	3 (0.9%)

Table 4. Risk Factors for Catheter-related Infection

Risk Factors	*P* Value
Patient's age	<0.001
Patients' job	<0.001
Patient's level of education	<0.001
Catheter location	<0.001
Prior catheter-related infection	<0.001
Lack of hand washing	0.002
Lack of using gloves	<0.001
Oral administration of antibiotics	<0.001
Use of topical antibiotic ointment	<0.001
Frequent change of catheter dressing	0.002

Our results represented that a higher proportion of patients aged between 30 and 40 years old had a catheter-related infection. However, contradictory results were found in this regard, indicating that older age was a risk factor for this issue. For example, Masashi et al found that cases aged more than 65 years old were at a higher risk of a catheter-related infection (15). Our findings can be due to the limited number of cases included in this age group.

The findings if our study further demonstrated that factors including the duration of catheter use and previous use of a hemodialysis catheter do not increase the risk of catheter-related infection. Conversely, Fram et al found that the duration of venous access and the presence of previous venous access were associated with an increased risk of a catheter-related infection (14). This difference may be due to different numbers of cases in our studied groups. Nevertheless, Fram et al (14) showed that the previous use of antimicrobials can increase the risk of catheter- related infection (CRI), which corroborates the findings of our study. Contrarily, Oliver et al reported that the increased duration of temporary hemodialysis venous catheters increases the risk of bacteremia (16).

Previous studies recommended the topical use of the alcohol-based antiseptic solution, chlorhexidine, as the first-line agent, at the time of central line insertion and during dressing changes in order to reduce the chance of CRIs (17). In another study, Paglialonga et al compared the use of povidone-iodine versus chlorhexidine gluconate and found that the topical administration of the latter agent was associated with a reduction in the incidence of exit-site, tunnel, and bloodstream infections in children undergoing hemodialysis (18). Our study confirmed that the topical use of the betadine solution has no significant effect on the reduction of CRI.

The topical administration of antibiotic ointment at the exit site, use of gloves, and hand hygiene performance are among other recommended measures in reducing the incidence of CRIs (17,19,20), which is in conformity with the results of our research.

The results of the present study further showed that patients' job and level of education can have a significant effect on the risk of CRIs. This increased risk may be attributed to the patients' personal hygiene and exposure to environmental pollutions. It was also found that the frequency of changing catheter dressing has a significant impact on the occurrence of bloodstream infections which can be due to the increased risk of organism transmission by hands.

This study had some limitations. Despite precise history taking, it cannot be claimed that recall bias did not occur in our work, particularly about old age patients. Moreover, the present study did not evaluate other factors that may influence the incidence of catheter-related infection, including patients' nutritional status and level of the economy, and psychosocial factors. Additionally, the study did not investigate patients' comorbid conditions that may increase the risk of catheter-related infection, particularly diabetes mellitus (15). Therefore, future larger-scale studies are required to assess other variables that may affect the prevalence of catheter-related infections among hemodialysis patients.

Conclusions

In general, the findings revealed that CRBI has still a significant prevalence among our hemodialysis population, and interventions are necessary for reducing modifiable risk factors for this issue. These interventions include the improvement of patients' education, catheter placement in locations with a lower risk of infection, hand washing by patients and health-care personnel, use of gloves by health-care personnel, oral administration of antibiotics and use of topical antibiotic ointment when necessary, and timely changing of catheter dressings.

Conflict of Interests

The authors have no conflict of interests to declare.

Ethical Approval

This research was approved by the Research Deputy of Shiraz University of Medical Sciences and its Ethics Committee.

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