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Switching temporary hemodialysis catheters to long-term catheters: exchange versus de-novo placement, any difference in line infection?

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Abstract. Background: Shifting from a short-term catheter to a long-term one is done either by removing the old catheter and placing a new long-term one via fresh new puncture site, or by replacing the old catheter with a long-term one over a guidewire. Aim: We aimed to describe our technique in changing a temporary line to a long-term catheter (LTC) over a guidewire and to determine the incidence of line-related infections following this procedure. Materials and methods: A retrospective pilot study was conducted between 2005 and 2010 at the American University of Beirut Hospital. We compared the first group (A), which consisted of 20 patients who underwent exchange of a short-term dialysis catheter with a tunneled one over a guidewire using our technique, to a second group (B) of 60 patients who underwent de-novo LTC placement. The two groups were matched by age, with a follow-up of at least 1 month. Results: The technical success rate of the catheter-conversion procedure was 100%. Our results revealed no significant difference of catheter duration between the two groups, with median duration of 6.5 vs. 4.0 days for group A and group B, respectively ($p = 0.21$). Moreover, there was also no significant mean time difference between any infection and long term catheter (LTC) insertion among the two groups ($p = 0.31$). Furthermore, there was no difference of catheter infection between the two groups ($p = 0.1$). Conclusion: We concluded that there was no difference in terms of side effects or risk of infection in the guidewire group when compared to standard technique.

Introduction

Vascular access is essential for hemodialysis (HD) patients. Maintaining entry sites and safeguarding future vascular pass is crucial. In case of urgent access for HD, uncuffed nontunneled HD catheters are the preferred option [1]. Yet, their use is time limited due to the high incidence of bacteremia, reported to reach 5.4% and 10.7% when placed in internal jugular or femoral veins, respectively [2]. In general, several conditions necessitate a dialysis process extending for more than a 3-week period. Examples are preparation for kidney transplant, failed or incomplete maturation of arteriovenous fistula (AV fistula) access, and current treatment for line infection [3]. In such cases, tunneled or permanent HD catheters are utilized. Several practicing physicians apply the de-novo placement technique when short-term or temporary HD catheters are substituted with permanent catheters. Keeping that in mind, it is important to mention that catheter-exchange technique over a guidewire has been effectively used for permanent and temporary access catheters. Moreover, it has been employed in both short to short-term and long to long-term catheter replacement [2]. The long-term catheter (LTC) insertion was done as a standard de novo procedure, and it has been shown that outcomes can be efficient and did not incur an infection risk step-up [4, 5]. Given the escalated utilization of LTCs and the limited literature on the subject, we aimed to review the clinical outcomes in terms of infectious complications associated with short-term to LTC guidewire-assisted exchange, compared to de-novo LTC placement in our institution.

Figure 1. Sutures are removed, and the catheter is pulled out slightly and flipped towards the back.

Figure 2. Only the catheter entry site is included in the sterile field.

Materials and methods

Catheter-replacement technique

Our suggested technique in doing the catheter exchange differs somewhat from what is described in the little available literature. It entails removing the sutures of the temporary line before starting the surgical sterilization and flipping the catheter completely to the back behind the neck area (Figure 1). Scrubbing and prepping are then performed and include only the entry site of the catheter in the skin and not the entire catheter as it is difficult to sterilize completely with its connections. Therefore, only the entry site of the catheter was included in the sterile field (Figure 2). Next, after changing our gloves to new sterile ones, lidocaine was used for administration of local anesthetic, ports were flushed with 10 cc of heparinized saline (1,500 units heparin/500 mL normal saline), and exchange was done by transecting the catheter in this clean area at the skin entry and introducing the exchange wire from the inner lumen, rather than from the connections, which are difficult to sterilize (Figure 3). The catheter is then removed over the wire after confirming the proper position of the wire by fluoroscopy. The tip of the removed catheter is routinely sent for culture. The LTC is placed in the usual manner, after which the old catheter entry site is debrided and its edges freshened up (Figure 4). A higher dose of heparin (5,000 units) was injected into the lumen at the end of the procedure. 2.0 silk was used to anchor the catheter to the skin. It is worth noting that the use of this exchange technique is not feasible in all patients, particularly when vein punctures are too high in the neck. In such instances, placement of an internal jugular LTC can result in kinking and subsequent occlusion of the catheter and is therefore best done using a new lower venous puncture.

Study design and participants

A retrospective pilot study was conducted between June 2005 and June 2010 at the American University of Beirut Medical Center in order to compare HD patients who underwent insertion of a new LTC via fresh new puncture site, to those replacing the old catheter with a long-term one over a guidewire. Data of 80 HD patients were retrospectively reviewed. Charts of 20 patients (group A) who underwent exchange of a short-term dialysis catheter with a tunneled one over a guidewire using our previously-mentioned technique were selected for the study. The second group (group B) consisted of 60 patients who underwent de-novo LTC placement during the same period and served as the control group. These two groups were matched by age. Antiplatelets were not

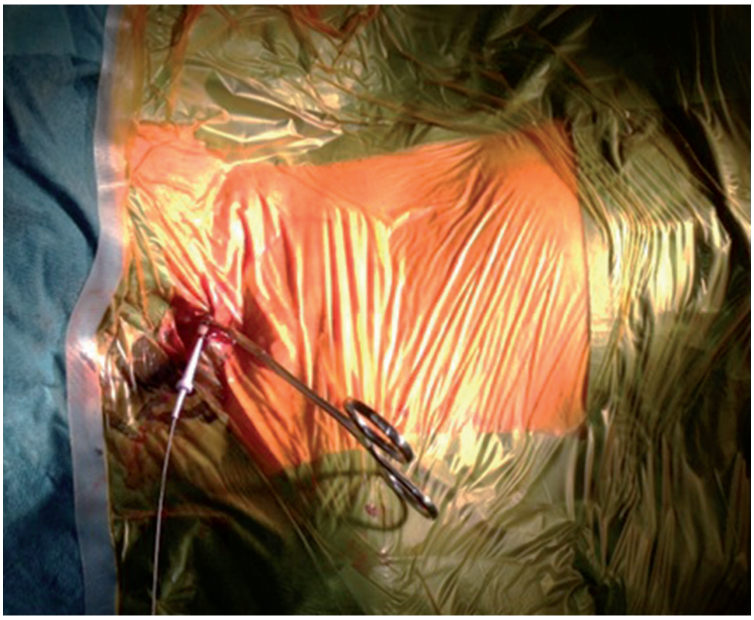

Figure 3. The temporary catheter is transected, and the exchange wire is introduced.

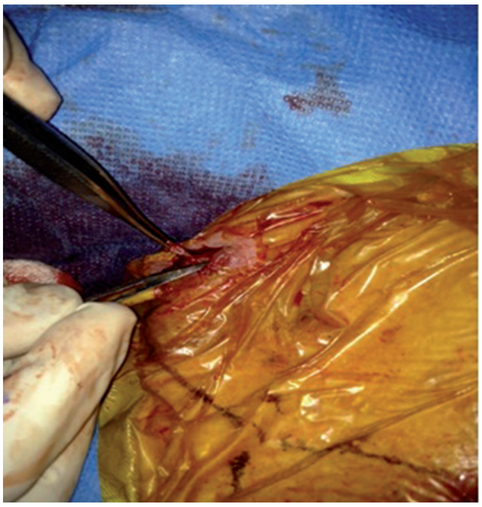

Figure 4. The entry site of the old catheter is debrided.

stopped on any of our study participants. The tunneled LTC used in all the cases was the Ash Split Cath® Catheter from Medcomp® (Medical Components, Inc. Harleysville, PA, USA). Patients who were not followed up for at least 1 month after catheter insertion were excluded from our study. Medical records were reviewed to gather patients' demographic data, comorbidities, and previous history of infection as well as to identify catheter type, site of insertion, reason for removal, and presence of any procedure-related complications. The technical success and clinical outcomes of catheter conversions were noted. All possible infections with details about site, type of culture, organisms involved, and management methods were recorded as well. The indication for tunneled catheter dialysis removal is defined by bacteremia, fever > 38 °C, sepsis, or clinical concerns for infection that are not explained otherwise. The outpatient dialysis unit was also contacted for any episodes suggestive of infections that did not require admission and therefore would have otherwise been missed from the inpatient record review.

Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 22. Sample characteristics (demographics and clinical variables) were analyzed using frequencies and percentages for categorical variables. Means and standard deviations were also performed for continuous variables with normal distribution and median and inter-quartiles for those with non-normal distribution. Pearson χ^2-test and Fisher exact test were used for categorical variables, and nonparametric Mann-Whitney U-test was performed for the continuous variables. A p-value ≤ 0.05 was considered statistically significant.

Results

The study group (group A) consisted of 20 patients (14 male and 6 female) who underwent exchange of a short-term dialysis catheter with a tunneled one over a guidewire and who were compared to 60 control patients (33 male and 27 female) (group B). The mean age of the two groups were 72.7 ± 10.1 and 71.0 ± 13.4 years, respectively. More details about these two groups are described in Table 1.

In the study group, all the 20 temporary catheters were successfully converted to tunneled HD without complications. Our results revealed no significant difference regarding the duration of temporary line before switching to a LTC, between the two groups, with a median of 6.5 and 4 days, respectively. Seven patients in group A had documented infections within 1 month prior to the LTC placement including osteomyelitis, urinary tract infections, and infected central lines among other infectious sources, while 13 patients in group B had documented infections within

Table 1. Baseline characteristics of our participants.

	Group A (N = 20) n (%)	Group B (N = 60) n (%)	p-value
Ages (Mean ± SD[a])	72.7 ± 10.1	71.0 ± 13.4	0.79
Gender			0.36
Male	14 (70)	33 (55)	
Female	6 (30)	27 (45)	
Hypertension	18 (90)	55 (92)	0.9
Diabetes Mellitus	13 (65)	32 (53)	0.52
Coronary artery disease	14 (70)	39 (65)	0.89
Dyslipidemia	12 (60)	22 (37)	0.12

Group A: 20 patients underwent exchange of a short-term dialysis catheter with a tunneled one over a guidewire; group B: 60 control patients who underwent de-novo LTC placement. [a]SD = standard deviation.

Table 2. Comparison between short-term/guidewire-assisted vs. de-novo catheter insertion.

	Group (A) (N = 20) n (%)	Group (B) (N = 60) n (%)	p-value
Temporary line days before LTC insertion (Median, IQ)[a,c]	6.5 (3 – 16)	4.0 (3 – 8)	0.21
LTC days before getting infected (Median, IQ)[a,c]	2 (0 – 330)	49 (26 – 270)	0.57
Any infection within 30 days before insertion[d]	7 (35)	13 (22)	0.18
Infection of LTC[b,d]	2 (10)	5 (8)	0.1
Antibiotic prophylaxis before insertion[d]	20 (100)	60 (100)	0.9
Days between any LTC insertion and infection (Median, IQ)[a,c]	2.5 (0 – 7)	5 (2 – 12)	0.31

[a]IQ = inter quartile; group A: 20 patients underwent exchange of a short-term dialysis catheter with a tunneled one over a guidewire; group B: 60 control patients matched who underwent de-novo LTC placement. [b]LTC = long-term catheter. [c]Mann Whitney U-test. [d]χ^2-test or Fisher exact test.

1 month prior to the catheter insertion ranging from urinary tract infections and superficial skin infections to infected venous access catheters. In addition, our results suggested that there was no statistically-significant difference of catheter infection between the two groups (p-value 0.1). In both groups, there were no catheter infections within the first 24 hours after insertion; 2 of 20 LTC subjects in group A (10%) developed infection with cultured bacteria being Pseudomonas and Enterobacter species. One of these infections occurred 330 days after the catheter insertion, whereas the second catheter got infected 2 days after its insertion. It is worth noting that the latter was a femoral LTC inserted due to thrombosed jugular veins and nonmaturing arteriovenous (AV) fistula. In group B, 5 out of 60 patients developed line infection (8%) with cultures growing Pseudomonas and Staph species. All patients received antibiotic prophylaxis (cephalexin 1 g, single dose) in the perioperative period. Moreover, there was also no significant mean time difference between any infection and LTC insertion among the two groups, p value = 0.31 (Table 2). No incidences of vascular complications or clinical venous stenosis were noted in either group during the study period.

Discussion

Our study contained two groups of patients who were compared to assess the infection rate in hemodialysis catheters. Subjects in the first group had a conversion of a short-term to long-term permanent catheter using the guidewire technique, preserving future venotomy sites, while the second set of patients underwent de-novo placement procedure. Our analysis showed no statistical differences in terms of infection rate between the two groups. In fact, the guidewire technique has been described in the literature in cases of exchange of temporary-to-temporary catheters and in cases of exchange of permanent-to-permanent catheters [2]. Such data reported low complication rate with a high success in preserving venotomy sites and dispensing future vascular access. Taking this into account, our results confirm the feasibility and good outcome of the guidewire technique over de novo catheter placement in preserving central venous entry for HD patients, providing treatment facilities with the same minimal complication rates offered by new-site catheter placement. This technique was described by Falk et al. [4] who found a similar infection rate among de novo and conversion techniques for a cohort of 42 patients. Generally speaking, kidney disease patients have multiple comorbidities, which affect their venous status and make it hard to find an access via the diseased veins. Moreover, catheter insertion is associated with venous thrombosis [6], worsening the chance of finding a venous access among HD patients. Therefore, it is important to exploit every venous site and limit the number of venous punctures. All our patients were on heparin while undergoing the procedure, which had a protective factor and the benefit of preventing venous thrombosis. In addition, a recent randomized control trial by Han et al. [7] investigating the role of high- versus low-dose heparin (5,000 units as cutoff) described a protective role of the lower dose in reducing risk of catheter-induced infections.

Despite an increasing body of evidence regarding the safety and efficacy of the exchange technique, it is still not widely applied among medical practitioners, mainly due to the lack of sufficient data in the literature. The general assumption among specialists entails a greater risk of catheter infection using the conversion technique when compared to de novo, but our paper reflects the opposite.

Short- and long-term catheter infection rates in the control group were similar with those described in the literature [8, 9]. Moreover, when analyzing the 2 cases of catheter infection in the study group, it is apparent that in 1 of the cases, the tunneled catheter became infected almost a year after its placement meaning that its infection was not related to the technique of insertion. In the control group, only 2 out of the 5 cases of catheter infection occurred within 30 days after insertion, with the earliest being after 18 days. Although the duration of the temporary line prior to the exchange and the presence of any coexistent infection prior to catheter placement theoretically could both predispose to infection in the LTC, our results in both groups failed to show an increased catheter infection rate in such cases, probably due to the small numbers in both groups. Catheter salvage using wide-spectrum antibiotics was attempted in all cases of catheter infections in both the study and the control group. However, this approach failed, and all involved catheters were eventually removed.

Some of the encountered limitations while drafting this manuscript were as follows: It is a retrospective study, and recruitments were only from a single center. Moreover, it is a pilot study with a relatively small sample size; it could be improved by additional, prospective, large cohort studies to ascertain that there is no increased infection while exchanging short-term catheters with long-term catheters over a guidewire. Another limitation was the use of the same LTC brand for all the patients in group A and group B. However, this also could be looked at positively since it eliminated more confounding variables in this relatively small sample size.

On the other hand, a study strength was the fact that placement and removal of the catheter were performed consistently by an expert vascular surgeon who ensured the safety and success of this procedure.

Conclusion

The current manuscript suggests that short-term to long-term dialysis catheter exchange over a guidewire is a safe and feasible substitute to the de-novo placement technique. Differences in terms of side effects were insignificant, and risk of infection was not pronounced in the guidewire conversion group when compared to the standard technique. Instead, both categories showed similar infectious pattern. Moreover, using the same entry site allowed for potential reduction in venous puncture-related complications and in conserving future vascular access sites. Future studies are encouraged for further evaluation using larger cohort size.

Conflict of interest

The authors of this manuscript report no monetary gain and no conflict of interest.

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