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# Prevention of Infections of Temporary Central Venous Hemodialysis Catheters. What Place for Local Antibiotic Prophylaxis?

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## Abstract

**Introduction:** Prevention of central venous catheter infections in hemodialysis is based on strict adherence to aseptic conditions and hygiene measures.

The aim of this work is to demonstrate the benefit of local antibiotic prophylaxis, in the form of an antibiotic ointment applied to the catheter emergence site, in the prevention of infections of temporary hemodialysis catheters.

**Material and Methods:** It is a tri-centric prospective study spread over a period of 12 years. We have divided the patients into 2 groups: the first includes all patients who receive local antibiotic prophylaxis after each dialysis session and the second constitutes the control group and includes all patients who do not receive any antibiotic prophylaxis. We have followed the fate of each hemodialysis catheter from its placement until its removal to detect the appearance of any infection that occurs.

**Results:** Our study demonstrated the effectiveness of local antibiotic prophylaxis in preventing local infections of catheters used in hemodialysis, with a non-significant reduction in the number of systemic infections and a prolongation of the duration of catheter use, without observing any cases of bacterial resistance.

**Conclusion:** Local antibiotic prophylaxis is useful in the prevention of systemic infections.

**Keywords: Hemodialysis Catheters; Infection; Local Antibiotic Prophylaxis**

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## Introduction

The use of temporary central venous catheter (CVC) for hemodialysis is very common in hemodialysis in daily practice, given the relative ease of placement on the one hand and the possibility of immediate use of this vascular approach. In fact, CVCs represent 7 to 39% of all vascular accesses in hemodialysis according to the authors [1, 2].

Several complications can arise after the installation of a CVC; Infection and thrombosis are the most common and are the leading cause of precipitous ablation of hemodialysis catheters [1-5].

In fact, 1% to 70% of hemodialysis catheters are complicated by a local or systemic infection requiring immediate catheter removal and more or less antibiotic therapy [1-7]. Since these infections can be serious and endanger the patient's life in 8 to 20% of cases [4, 6,7] and that in some cases CVC is the only vascular approach available, prevention of these infections is essential and should be an integral part of the catheter placement and handling procedures.

The majority of hemodialysis catheter infection prevention measures insist on the general aseptic conditions on the one hand and the nature of the lock used after each manipulation on the other hand [8-11].

The value of aseptic measures is indisputable and uncontroversial [8 - 11]. The use of antibiotic prophylaxis for prevention of catheter infections is found in the literature in the form of locks containing antibiotics (gentamicin, apicillin or others), but the application of an antibiotic ointment to the catheter exit site is rarely described in the literature.

The aim of this work is to demonstrate the benefit of local antibiotic prophylaxis, in the form of an antibiotic ointment applied to the catheter emergence site, in the prevention of infections of temporary hemodialysis catheters.

## Material and Methods

It is a tri-centric prospective study spread over a period of 12 years from November 2013 to November 2025 including 92 hemodialysis patients treated in three hemodialysis centers: provincial hemodialysis center - Midelt, provincial hemodialysis center August 20 - Azrou and provincial hemodialysis center - Elhajeb.

### We distributed the patients into two groups

-**First group:** Includes all patients who receive local antibiotic prophylaxis after each dialysis session from the placement of the venous catheter until its removal.

-**Second group:** constitutes the control group and includes all the patients who do not receive any antibiotic prophylaxis.

Aseptic conditions and hygiene measures were strictly observed during catheter insertion in both groups. We insisted on the following measures: washing hands of the operator and the helper, wearing a gown and sterile gloves and also: bib and callot and use of sterile and single-use equipment.

### Local antibiotic prophylaxis

**Aim:** Obtaining effective antibiotic prophylaxis against the germs most often responsible for infections of hemodialysis catheters, namely gram-positive cocci (*staphylococcus epidermidis* and *staphylococcus aureus*) [4, 6, 8, 12] without causing the development of bacterial resistance.

### We have strictly observed the following principles

We excluded from the study patients who received antibiotic therapy that has an anti-staphylococcal action, above all: patients on anti-bacillary drugs and patients with rheumatic fever on antibiotic prophylaxis.

We opted for a fusidic acid ointment applied to the catheter emergence site after each hemodialysis session, generally: twice a week.

### Catheter infection is defined as follows

-**Local infection**: inflammation at the point of emergence, pus and bad odor.

-**Systemic infection**: presence of signs of local infection and a general clinical and biological infectious syndrome.

If an infection occurs, the catheter is immediately removed. A bacterial culture is taken. Systemic antibiotic treatment is prescribed after catheter removal only if the infection persists for more than 24 hours.

We studied demographic, clinical and laboratory data for each patient, the fate and total duration of catheter use and the "time" to onset of infection.

The statistical study is carried out using SPSS IBM 19. The quantitative variables are expressed as means and standard deviation. The qualitative variables are expressed in number and percentage. The statistical analysis is performed by univariate and multivariate logistic regression.

## Results

The average age of our patients is 52.4 ± 15.7 years with a predominance of men: sex- ratio = 60 men /32 women = 1.87. Among these patients: 28 (30.4%) are diabetics, 37 (40.2%) are hypertensive, two patients have lupus and 3 patients are followed for microscopic angiitis.

All patients receive two hemodialysis sessions per week. They are taken care of by the same medical and paramedical team in each center: 58 patients at the provincial hemodialysis center -20 August - Azrou, 14 patients at the provincial hemodialysis center - El hajeb and 20 patients at the provincial hemodialysis center - Midelt.

They benefited from the placement of 92 CVC, including 22 (23.9%) at the jugular vein and 70 (76.1%) at the right or left femoral vein.

The patients are divided into two groups: (Table 1).

**-First group: Local antibiotic prophylaxis**

Includes 50 patients, their mean age is 49.1 ± 18.1 years with a sex ratio = 1.38. These patients benefited from the placement of 50 CVC, including 14 (28%) in the jugular vein and 36 (72%) in the femoral vein. The average duration of catheter use is 3.02 ± 2.01 months.

Catheter infection occurred in 7 cases, or 14% of all catheters in this group. It occurred after an average duration of use of **3.4 ± 1.8** months. It is a local infection in 4 cases (8%) and a systemic infection in 3 cases (6%). It required catheter removal in all cases with spontaneous disappearance of infectious signs without recourse to systemic antibiotic therapy in 2 cases and one patient requires systemic antibiotic therapy which includes flucloxacillin: 1g/12h and gentamicin 80 mg/48h.

Culture of the catheter tip has shown it to be a *staphylococcus* in all cases of systemic infection. It is a *staphylococcus epidermidis*

**Table 1:** Characteristics of the two groups.

| | First group 50 patients (50 Catheters) | Second group 42 patients (42 Catheters) |
|---|---|---|
| Average age (years) | 49.1 ± 18.1 | 56.3 ± 11.4 |
| Sex ratio (men / women) | 1.38 | 2.8 |
| Diabetes | 12 (24%) | 15 (35.7%) |
| HTA | 16 (32%) | 21 (50%) |
| Lupus | 2 (4%) | 0 |
| Angiitis | 3 (6%) | 0 |
| Jugular catheter | 14 (28%) | 8 (19%) |
| Femoral catheter | 36 (72%) | 34 (80.9%) |
| Catheter infection<br>- Jugular catheter<br>- Femoral catheter | **7 (14%)**<br>1/14 (7.1%)<br>6/36 (16.6%) | **26 (61.9%)**<br>4/8 (50%)<br>22/34 (64.7%) |
| Time to infection (months) | **3.4 ± 1.8** | **2.3 ± 1.5** |
| Local infection | 4(8%) | 10 (23.9%) |
| Systemic infection | 3 (6%) | 16 (38%) |
| Systemic infection requiring antibiotic therapy | 1(2%) | 5(11.9%) |
| Germ responsible for cases of systemic infection:<br>-*Staphylococcus epidermidis* methi-S<br>-*Staphylococcus epidermidis* methi-R<br>-*Staphylococcus aureus* methi-S<br>-*Staphylococcus aureus* methi-R | <br>3<br>0<br>0<br>0 | <br>3<br>0<br>2<br>0 |

**Table 2:** Statistical analysis by univariate logistic regression.

| | Catheter infection N = 33 (35.8%) | No catheter infection N= 59 (64.2%) | Raw OR | CI | *p* |
|---|---|---|---|---|---|
| Average age (years) | 54.9 ± 10.7 | 51 ± 17.8 | 1.02 | [0.989; 1.05] | 0.25 |
| **Sex ratio** | **26/7** | **34/25** | **0.366** | **[0.129; 0.942]** | **0.045** |
| **Diabetes** | **15 (45.4%)** | **13 (22%)** | **2.95** | **[1.180; 7.540]** | **0.021** |
| **Local Antibiotic prophylaxis** | **7 (21.2%)** | **43 (72.9%)** | **0.10** | **[0.0341; 0.264]** | **<0.001** |
| Catheter duration (months) | 2.5 ± 1.6 | 2.7 ± 1.88 | 0.998 | [0.972; 1.02] | 0.84 |

**Table 3:** Statistical analysis by multivariate logistic regression.

| | Adjusted OR | CI | *p* |
|---|---|---|---|
| Sex ratio | 0.386 | [0.118;1.17] | 0.7 |
| Diabetes | **3.29** | **[1.10 ;10.7]** | **0.038** |
| Antibiotic prophylaxis | **0.0927** | **[0.0287;0.260 ]** | **<0.001** |

methi-S sensitive to common antibiotics.

**-Second group: Control**

Includes 42 patients, their mean age is 56.3 ± 11.4 years with a sex ratio = 2.8. These patients benefited from the placement of 42 CVC, including 8 (19%) in the jugular vein and 34 (80.9%) in the femoral vein. The average duration of catheter use is 2.15 ± 1.30 months.

Catheter infection occurred in 26 cases, or 61.9% of all catheters in this group. It occurred after an average duration of use of **2.3 ± 1.5** months. It is a local infection in 10 cases (23.8%) and a systemic infection in 16 cases (38%). It required removal of the catheter in all cases with spontaneous disappearance of infectious signs in 11 cases and recourse to general antibiotic therapy which includes flucloxacillin: 1g/12h and gentamicin 80 mg/48h. In 5 cases.

Culture of the catheter tip has shown it to be a staphylococcus in all cases of systemic infection. It is a staphylococcus epdermidis methi-S sensitive to common antibiotics in 3 cases and a staphylococcus aureus methi-S in 2 cases.

Statistical analysis shows that hemodialysis catheter infections are four times less frequent in the group that had local antibiotic prophylaxis. This difference is statistically significant (p <0.001) (Tables 2 and 3).

### We noted the following observations

-Systemic infection is 6 times less frequent in the first group compared to the second (6% *versus* 38%).

-Local infection is 3 times less frequent in the first group compared to the second (8% *versus* 23.8%).

-The infection occurs later in the first group compared to the second group (**3.4 ± 1.8** *versus* **2.3 ± 1.5** months) but this difference is not significant.

On the other hand, we also noticed that diabetes is a significant risk factor associated with the occurrence of a catheter infection (p= 0.038). In fact, it increases the risk of developing a catheter infection by 3.29.

Male sex is a risk factor associated with catheter infection in univariate analysis with p= 0.045, but in multivariate analysis it is not significant (p=0.7).

Finally, the study showed that infections are more frequent when femoral catheters are inserted. However, the small number of jugular catheters does not allow adequate statistical analysis.

## Discussion

Our study demonstrated efficacy of local antibiotic prophylaxis in the prevention of infections of CVCs used in hemodialysis with a reduction in severity and prolongation of the duration of catheter use without noting any cases of bacterial resistance. This type of local antibiotic prophylaxis has not been described in the literature for separate cases only and not in complete series [12]. We found in the literature a local antibiotic prophylaxis based on an antibiotic lock (gentamicin or amykacin) and not on an ointment applied to the catheter insertion site [13, 14].

This effectiveness of local antibiotic prophylaxis must in no case lead to neglect of the aseptic conditions and hygienic measures during the installation of a central venous catheter and at each manipulation, which constitute the cornerstone of any strategy. infection prevention [8 - 11].

While systemic antibiotic prophylaxis should be reserved for specific cases and limited indications, local antibiotic prophylaxis can be used in many patients without fear of developing serious bacterial resistance.

The particularly high frequency of catheter infections in diabetic patients and patients with femoral catheters may guide our decision on local antibiotic prophylaxis. It would be advisable to prescribe local antibiotic prophylaxis when the CVC will be used for several weeks (the only vascular approach available) and placed in the femoral vein in a diabetic patient (immunocompromised). Some authors have notably reported diabetes and the femoral CVC site as risk factors associated with the onset of catheter infection [13-15], but this association is not always significant [12 - 17].

Local antibiotic prophylaxis is also characterized by its low cost and ease of use.

## Conclusion

Our study demonstrated the benefit of local antibiotic prophylaxis in the prevention of hemodialysis CVC infections, Let us insist once again on the strict observance of aseptic conditions and hygienic measures.

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