



# Prevention of Thrombosis of Central Venous Hemodialysis Catheters

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## Abstract

**Introduction:** Central venous catheter thrombosis is a frequent complication in hemodialysis responsible for catheter dysfunction which most often requires its removal and the insertion of a new catheter.

**Objective:** To develop an effective preventive strategy for thrombosis of central venous hemodialysis catheters.

**Material and Methods:** We carried out a tri-centric prospective study concerning the prevention of thrombosis of hemodialysis catheters. We compared the effectiveness of a lock based on a mixture of low molecular weight heparin and standard heparin with a conventional lock based on standard heparin alone.

**Results:** Our study demonstrated remarkable effectiveness of the lock based on a mixture of low molecular weight heparin and standard heparin in the prevention of thrombosis of hemodialysis catheters with an extension of the duration of use of the catheter without noting any cases of hemorrhagic syndrome.

**Conclusion:** Despite the limited size of our study, it was able to demonstrate satisfactory and significantly better efficacy in the prevention of thrombosis of hemodialysis catheters.

**Keywords:** Central Hemodialysis Catheters; Thrombosis; Prevention

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## Introduction

Central venous catheter (CVC) placement is common practice in hemodialysis, given the relative ease of placement on the one hand and the possibility of immediate use of this vascular access on the other hand. Indeed, CVC represent 7% to 39% of all vascular accesses in hemodialysis according to the authors [1, 2].

Thrombosis is one of the most common complications that can occur after placement of a CVC, it is one of the main causes of hasty removal of hemodialysis catheters [1-5].

Indeed, 25% to 40% of hemodialysis catheters are complicated by thrombosis requiring immediate removal of the catheter [6-9]. Prevention of these thrombosis is essential and must be an integral part of the procedures for placing and handling catheters, especially since in some cases, the CVC is the only vascular access available.

Prevention of CVC thrombosis requires rinsing with 0.9% saline serum of the two lumens of the catheter at the end of the hemodialysis session followed by injection of a lock of anticoagulant, most often: standard heparin.

**Objective:** In this work, we report a reflection on the prevention of CVC thrombosis by a lock based on a mixture of low molecular weight heparin (LMWH) and standard heparin.

## Material and Methods

We conducted a prospective three-center study spread over a period of 11 years from November 2011 to October 2024 including 103 chronic hemodialysis patients treated in three hemodialysis centers: the provincial hemodialysis center -Midelt, the provincial hemodialysis center 20 Aout - Azrou and the provincial hemodialysis center - Elhajeb.

It should be noted that these patients had constraints that delayed the creation of the arteriovenous fistula (AVF) or its puncture, in particular: poor atheromatous vascular condition, failure to create the AVF, need for specific vascular radiological exploration, insufficient development of the venous cord; which led us to preserve the CVC for the performance of hemodialysis sessions.

The CVCs used are long-term tunneled catheters made of silicone. Patients are divided into two groups according to the order of their admission to the hemodialysis centers.

-The first group includes all patients who after each dialysis session benefit, after rinsing the two lumens of the catheter with saline serum, from a systematic locking of the catheter by a lock based on a mixture of standard heparin and low molecular weight heparin. This manipulation is well respected from the insertion of the venous catheter until its removal. The lock is prepared as follows: in a sterile 5 cc syringe, a dose of enoxaparin sodium 4000 IU/0.4 cc is placed, to which 3.2 cc of standard heparin is added, for a total volume of 3.6 cc. The latter is then used to lock the catheter: half is injected into the arterial lumen and the other half is injected into the venous lumen.

-The second constitutes the control group and includes all the patients who, after each dialysis session, benefit, after rinsing the two lumens of the catheter with saline serum, from a systematic locking of the catheter with a lock based on pure standard heparin. This manipulation is well respected from the insertion of the venous catheter until its removal.

We excluded from the study patients receiving anticoagulation based on LMWH or anti-vitamin K or treatment based on antiplatelet agents: aspirin or clopidogrel and also patients who have an innate coagulation disorder.

We carefully followed the fate of each hemodialysis catheter from its insertion to its removal to detect the occurrence of a possible thrombosis.

We studied for each patient the demographic, clinical, biological data, the fate and total duration of use of the catheter and the "time" of occurrence of thrombosis.

The statistical study is carried out using Excel Word 2007 software. Quantitative variables are expressed as means - standard deviation when they respond to the normal distribution and as interquartile medians when they are outside the normal distribution. Qualitative variables are expressed as percentages. Statistical analysis is performed by univariate and multivariate logistic regression.

## Results

The average age of our patients is  $52.6 \pm 15.5$  years with a male predominance: sex ratio =  $66/37 = 1.78$ . Among these patients: 31.06% are diabetic, 40.7% are hypertensive, 4 patients are lupus and three patients are followed for microscopic angiitis.

All patients are hemodialyzed at a rate of two sessions per week. Their care is provided by the same medical and paramedical team in each provincial hemodialysis center: 69 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 a total number of 146 CVC, including 42 (28.7%) at the jugular vein and 104 (71.2%) at the right

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

	First group 43 patients (80 Catheters)	Second group 60 patients (66 Catheters)
Average age (years)	$52.9 \pm 16.6$	$52.7 \pm 14.9$
Sex ratio (male/female)	1.26	2.33
Diabetes	13 (30.2%)	19 (31.6 %)
Jugular catheter	33 (41.2%)	8 (12.1%)
Femoral catheter	47 (58.8%)	58 (87.9%)
<b>Catheter thrombosis</b>	<b>4 (5%)</b>	<b>26 (39.4%)</b>
- Jugular catheter	2 (50%)	7 (26.9%)
- Femoral catheter	2 (50%)	19 (73.1%)
<b>Thrombosis time (months)</b>	<b><math>2.5 \pm 1.7</math></b>	<b><math>2 \pm 1</math></b>

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

	Thrombosis 30 (20.5%)	No thrombosis 116 (79.5%)	OR brut	CI	P
Average age (years)	$56.1 \pm 15.6$	$51.4 \pm 15.4$	1.02	[0.992; 1.06]	0.16
Sex-ratio M/W	2.37	1.62	1.07	[0.414; 2.88]	0.89
Diabetes	5 (18.5%)	27 (35.5%)	0.512	[0.177; 1.36]	0.19
<b>LMWH + Heparin</b>	<b>4 (13.3%)</b>	<b>76 (65.5%)</b>	<b>0.081</b>	<b>[0.0227; 0.225]</b>	<b>&lt;0.001</b>
Duration (months)	$2.18 \pm 1.3$	$3.32 \pm 2.7$	0.881	[0.610; 1.16]	0.45

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

	OR	CI	P
<b>LMWH + Heparin</b>	<b>0.0959</b>	<b>[0.0255; 0.279]</b>	<b>&lt; 0.001</b>
Duration (months)	0.881	[0.610; 1.16]	0.45

or left femoral vein.

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

**-First group:** Locking of the catheter by a mixture of LMWH + standard Heparin:

Includes 43 patients, their average age is  $52.9 \pm 16.6$  years with a male predominance: a sex ratio =  $24/19 = 1.26$ . These patients benefited from the placement of 80 hemodialysis catheters, including 33 (41.2%) at the jugular vein and 47 (58.8%) at the femoral vein. The average duration of use of the catheters is  $3.8 \pm 3.1$  months.

Catheter thrombosis occurred in 4 cases or 5% of all catheters in this group. It occurred after a mean duration of use of  $2.5 \pm 1.7$  months and required removal of the thrombosed catheter.

**-Second group:** Control, locking with pure standard heparin.

Includes 60 patients, their mean age is  $52.7 \pm 14.9$  years with male predominance: a sex ratio of  $42/18 = 2.33$ . These patients benefited from the placement of 66 hemodialysis catheters, including 8 (12.1%) at the jugular vein and 58 (87.9%) at the femoral vein. The mean duration of catheter use is  $2.12 \pm 1.04$  months.

Catheter thrombosis occurred in 26 cases or 39.4% of all catheters in this group. It occurred after a mean duration of use of  $2.1 \pm 1.2$  months. It required catheter removal in all cases.

Statistical analysis shows that thrombosis of hemodialysis catheters is seven times less frequent in the first group. This difference is statistically significant ( $p < 0.001$ ) (Tables: 2 and 3).

## Discussion

Our study demonstrated a remarkable efficacy of the lock based

on LMWH mixture and standard heparin in the prevention of thrombosis of CVCs used in hemodialysis with an extension of the duration of use of the catheter without noting any case of hemorrhagic syndrome.

Such a lock seems particularly interesting in the case of catheters with prolonged use, for example: a tunneled catheter in a chronic hemodialysis patient who no longer has vascular sites allowing the creation of an arteriovenous fistula.

However, this lock has not been tested in patients on anticoagulants, for whom it is better to avoid such a lock to avoid causing coagulation disturbances or hemorrhagic incidents.

We have not found in the published literature similar studies concerning the use of LMWH associated with standard heparin for locking hemodialysis catheters. Most studies compare the antithrombotic efficacy of standard heparin and citrate alone or associated with antibiotics but not LMWH.

## Conclusion

Despite the limited number of people in our study, it demonstrated satisfactory and significantly better efficacy of the lock based on the combination of LMWH and standard heparin in the prevention of thrombosis of hemodialysis catheters.

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