

# Le Bulletin de la Dialyse à Domicile

**HOME HEMODIALYSIS : IS THERE STILL ROOM FOR HIGH DIALYSATE FLOW RATE ?**

**Hémodialyse à domicile :  
y a-t-il encore une place pour le haut débit de dialysat ?**

Note : le texte original en version Française est disponible à la même adresse url : <https://doi.org/10.25796/bdd.v1i2.48>

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Travail présenté en communication orale lors des 1ères Journées Francophones de Dialyse à Domicile  
(Toulouse, 21-22 juin 2018)

## Résumé

La disponibilité en France, durant la dernière décennie, de moniteurs d'hémodialyse à bas débit de dialysat, spécifiquement adaptés pour la dialyse quotidienne (5 à 6 séances par semaine), est contemporaine d'un véritable renouveau de l'hémodialyse à domicile. Si les bénéfices cliniques de l'hémodialyse quotidienne à haut débit de dialysat et de l'hémodialyse longue nocturne trihebdomadaire, qui sont deux modalités d'hémodialyse intensive, ont bien été démontrés, ils le sont beaucoup moins en ce qui concerne l'hémodialyse à bas débit de dialysat. Ainsi certains patients pourraient-ils encore souhaiter utiliser des moniteurs classiques d'hémodialyse afin de pouvoir restreindre le nombre de séances (et donc de ponctions de l'abord vasculaire) à 3 par semaine (ou à 1 jour sur 2) ou bénéficier d'une modalité d'hémodialyse intensive.

Mots clés : hémodialyse à domicile – hémodialyse intensive – hémodialyse quotidienne – Kt/V standard

## Abstract

The availability in France, for the last decade, of low dialysate flow rate hemodialysis monitors, specifically adapted for daily hemodialysis (5 to 6 sessions per week), is contemporary with a real renewal of home hemodialysis. The clinical benefits of daily hemodialysis with high dialysate flow and of thrice-weekly long nocturnal hemodialysis, which are two intensive hemodialysis modalities, have been demonstrated ; however they are less well demonstrated with low dialysate flow hemodialysis. Thus, some patients may still wish to use conventional hemodialysis monitors in order to limit the number of sessions (and therefore the number of vascular punctures) to 3 per week (or every other day) or wish to benefit from a modality of intensive hemodialysis.

Keywords : home hemodialysis, intensive hemodialysis , daily hemodialysis, standard Kt/V

## INTRODUCTION

The availability in France, over the last decade, of hemodialysis monitors specially adapted for home treatment seems to have led to a real revival of home hemodialysis, which has been in constant decline since the 1990s [1]. These monitors have the particularity of using dialysis fluids which are ready for use and delivered in 5-liter bags, and which require, for obvious reasons of storage volume and transport cost, to limit their consumption to around 150 liters per week. Under these conditions: 1) to maintain a weekly dialysis duration of at least 12 hours, the treatment must be performed at a low dialysate flow rate (less than 200 ml/min), which reduces its effectiveness compared to conventional treatment (dialysate flow rate between 500 and 800 ml/min); 2) to compensate for this decrease in effectiveness, the frequency of sessions must be increased to at least 5 per week and without a weekend, which defines daily hemodialysis. These monitors are therefore dedicated to daily dialysis at home at low dialysate flow rates.

This new treatment modality, currently in full expansion, seems to have completely replaced home hemodialysis performed with conventional generators, so it is logical to ask whether there is still a place for home hemodialysis using generators with a generally high dialysate flow rate (at least 500 ml/min). After clarifying what intensive hemodialysis is, we will discuss the potential benefits of high dialysate flow rate hemodialysis, as well as the reasons why it may still be chosen by some patients.

### WHAT IS INTENSIVE HEMODIALYSIS?

Intensive hemodialysis is a highly effective mode of hemodialysis compared to conventional hemodialysis. This increase in efficiency cannot generally be achieved by increasing the dialyzer's performance, which is already optimal in relation to the efficiency of internal transfers in the body. It therefore requires an increase in the weekly duration of treatment and/or frequency of sessions compared to the 12 weekly hours of treatment in 3 sessions per week of conventional hemodialysis. However, there is no consensus definition of intensive hemodialysis, particularly with regard to the minimum weekly duration of treatment, which according to the authors may be 15, 18 or even 24 hours.

In reality, the effectiveness of dialysis treatment is traditionally measured by  $Kt/V$ -standard, or  $(Kt/V)$  st, which takes into account both the performance of each of the weekly sessions (the weekly  $Kt/V$  is equal to the sum of the  $Kt/V$ s of all one-week sessions) and their fractionation during the week (session frequency). It would therefore seem logical to define intensive

hemodialysis as a modality that delivers a significantly higher  $(Kt/V)$ st than conventional hemodialysis.

Leygoldt's formula (see appendix) seems to be the most appropriate method to calculate the  $(Kt/V)$ st for different hemodialysis regimens [2]. Thus, we can calculate a  $(Kt/V)$ st equal to about 2.2 for a conventional pattern of 3 weekly 4-hour sessions. It would then seem logical to define intensive hemodialysis as a modality that allows a much higher  $(Kt/V)$ st, for example at least 2.6.

For the other modalities, this formula makes it possible to calculate (see appendix):

- a  $(Kt/V)$ st equal to about 2.65 for daily high dialysate flow rate hemodialysis
- a  $(Kt/V)$ st equal to about 2.25 for daily low dialysate flow rate hemodialysis
- a one  $(Kt/V)$ st equal to about 2.65 for triweekly nocturnal long hemodialysis
- a one  $(Kt/V)$ st equal to about 2.55 for conventional alternate-day hemodialysis.

Thus, triweekly nocturnal long hemodialysis and daily high dialysate flow rate hemodialysis are intensive hemodialysis modalities, but daily low dialysate flow rate hemodialysis is not. Conventional alternate-day hemodialysis appears to be similar to intensive hemodialysis.

### WHAT ARE THE BENEFITS OF INTENSIVE HEMODIALYSIS?

The benefits of intensive hemodialysis have been established for many years. Of particular note are the French teams of Dr Guy Laurent at the centre of Tassin la Demi-Lune for triweekly nocturnal long hemodialysis [3], and Pr Jules Traeger in Lyon for short daily high dialysate flow rate hemodialysis [4]. Compared to conventional triweekly hemodialysis, these two modalities have in common a better control of phosphatemia and nutritional status as well as an improvement in blood pressure control with a significant and sometimes total reduction in antihypertensive treatment and a decrease in Left Ventricular Hypertrophy LVH [5]. Regarding mortality, observational studies have shown a very significant reduction in mortality, both in triweekly nocturnal long hemodialysis [6] and in daily high dialysate flow rate hemodialysis [7]. The only randomized mortality study is the FHN-trial which showed a relative risk of 0.61 (compared to the triweekly conventional hemodialysis group) for the composite criterion "death or increase in LVH" (the 1-year follow-up was insufficient to take death alone as the main criterion) [8] for the group treated with daily high dialysate flow rate hemodialysis. This study also showed better control of hypertension and phosphatemia, as well as a greater number of vascular access interventions in the daily hemodialysis group.

However, there are very few studies comparing daily low dialysate flow rate hemodialysis with conventional triweekly hemodialysis. An observational study [9] showed a comparable, although very slightly decreased, mortality, which can be related to the fact that the (Kt/V)<sub>st</sub> could be slightly increased. Another study [10] showed no improvement in hyperphosphatemia and nutritional status (no increase in dry weight or albuminemia) but showed a decrease in interdialytic weight gain and an improvement in hypertension with a reduction in antihypertensive therapy. It therefore seems that these benefits could be due to the simple increase in the frequency of sessions and would therefore be related to the decrease in the duration of the interdialytic interval. However, these benefits were unconfirmed by another study [11] which did not show any significant variation in blood pressure or any significant reduction in antihypertensive treatment, but only showed a decrease in blood pressure variability. Overall, the benefits of intensive hemodialysis, and in particular daily hemodialysis at high dialysate flow rates, should not systematically be attributed to daily low dialysate hemodialysis until proven. However, there is no reason not to offer patients, if they so wish, a daily dialysis regimen with a low dialysate flow rate since it seems at least as effective as a conventional triweekly regimen with a high dialysate flow rate.

### **WHY CHOOSE HOME HEMODIALYSIS WITH A HIGH DIALYSATE FLOW RATE?**

There are several reasons that may motivate patients to perform hemodialysis treatment at home. Indeed, home hemodialysis makes it possible to avoid transport times and to have greater flexibility in session schedules, which makes it more compatible with a socio-professional activity or with family life. In addition, home hemodialysis requires autonomy that makes the patient a true actor in his or her treatment, leading to a better quality of life [10]. Although low-flow daily hemodialysis appears to be appropriate for the majority of patients who have chosen home hemodialysis, high dialysate flow rate hemodialysis may be chosen by some for a variety of reasons.

First, for patients for whom a 4-hour triweekly session schedule provides a satisfactory quality of life, high dialysate hemodialysis reduces the number of sessions (and therefore the number of vascular access punctures). It also makes it possible to carry out, without significantly increasing the constraint, a dialysis regimen on alternate days (1 session on 1 day out of 2) which, by eliminating weekends, seems in common practice to provide the patient with a large part of the benefits

of daily hemodialysis (better control of hypertension with reduced antihypertensive treatment, reduction in LVH) [12], perhaps because its Kt/V is close to that of intensive hemodialysis.

In addition, some patients may find it easier to fit 5 to 6 sessions of 2:00 to 2:30 each week, rather than 3 sessions of 4 hours, into their professional or socio-family agenda. It may then be easier for some of them to find space for an individual osmosis unit than to make available the volume necessary to store dialysate bags, the delivery of which cannot always, for cost reasons, be carried out as frequently as they would like. Other patients may also prefer to schedule nocturnal long hemodialysis, either triweekly or on alternate days, which requires a dialysate volume well above 150 liters per week. Finally, some patients may choose an intensive mode of hemodialysis (short daily hemodialysis at a high dialysate flow rate, triweekly nocturnal long hemodialysis, or alternate-day hemodialysis), either pragmatically because they feel the beneficial effects on their quality of life, or on principle because they have been informed of its potential benefits.

### **HEMODIALYSIS AT HOME AND PATIENT EDUCATION**

Since the availability of daily dialysis at low dialysate flow rates is contemporary with a revival of home hemodialysis, it is logical to ask whether there is a causal link. Because daily low flow rate hemodialysis represents a new therapeutic modality and because innovations in the practice of dialysis are not so frequent, this new modality has aroused the curiosity of the current generation of nephrologists who until now had not shown much interest in home hemodialysis, which was then in constant decline and in which they had mostly never been trained.

It is therefore possible that the renewed interest of patients in home hemodialysis is actually due to the development, wanted by the regulatory authorities as well as by patients' associations, of information for patients about the different dialysis modalities. Because of this desired development, nephrologists have been led to offer home hemodialysis in the same way as other dialysis modalities. However, it is not certain that these nephrologists have been objective when presenting: 1) on the one hand, high dialysate flow rate hemodialysis, which they know little or nothing about and which is never presented to them by laboratories that offer conventional monitors and for which home represents only a negligible fraction of the market; 2) on the other hand, low-dialysate flow rate hemodialysis, in which

they are strongly involved with by laboratories that offer only this type of monitor specifically adapted to home.

## CONCLUSION

Although low-flow daily dialysis is the modality chosen by the majority of patients who have opted for home hemodialysis, high-flow dialysis may still be the preferred option for some of them, particularly because it reduces the number of sessions (and therefore vascular access punctures) and can be performed at night (freeing up the daytime available for work, leisure or family). It would be regrettable if, because of what could resemble a fashion effect, this modality was no longer offered to them and therefore abandoned by dialysis associations, even if it remains necessary for manufacturers to adapt hemodialysis monitors operating with a high flow rate more specifically to the home, drawing inspiration if necessary from the technological innovations already developed on hemodialysis monitors operating with a low flow rate.

## APPENDIX

The most commonly used approach to calculate the (Kt/V)<sub>st</sub> is the use of Leypoldt's formula, namely:

$$(Kt/V)_{st} = [1 - \exp(-A)] / B$$

with:

$$A = eq(Kt/V)$$

$$eq(Kt/V) = 0.924 sp(Kt/V) + 0.056 - 0.395 sp(Kt/V) / t$$

sp(Kt/V): single pool Kt/V

t: duration of the session in hours

and:

$$B = (1/N) - Q + Q[1 - \exp(-A)] / A$$

N: number of sessions per week

Q: session duration/week duration (i.e.: t/168)

For a conventional hemodialysis regimen, i.e. 3 weekly sessions of 4 hours at a high dialysate flow rate with a sp(Kt/V) of at least 1.4 per session, the result is a (Kt/V)<sub>st</sub> of about 2.2. For daily hemodialysis (6 sessions of 2 hours per week) performed with the same equipment and under the same conditions, except for the duration of the session and therefore with a sp(Kt/V) reduced by half to 0.7 for a session of half duration, Leypoldt's formula estimates a (Kt/V)<sub>st</sub> at 2.63. If daily hemodialysis is performed at a low dialysate rate resulting in a reduction of sp(Kt/V) to 0.55 for a 2-hour session, the (Kt/V)<sub>st</sub> is calculated at 2.25. For nocturnal long hemodialysis (3 weekly sessions of at least 7 hours duration with a dialysate flow rate of 200 ml/min, which corresponds to a sp(Kt/V) equal to  $(7/2) \times 0.55 = 1.9$  for a 7-hour session), the (Kt/V)<sub>st</sub> is calculated at 2.63. For conventional hemodialysis (4-hour sessions with a sp(Kt/V) of 1.4) on

alternate days (7 sessions every 14 days or 3.5 sessions per week), the (Kt/V)<sub>st</sub> is calculated at 2.55.

## DISCLAIMERS

*The author reports no conflict of interest.*

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*Received 2018/07/21, accepted after revision 2018/07/26  
published 2018/09/25*

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