

## Time to recovery after a hemodialysis session: impact of selected variables

Kwabena T. Awuah<sup>1</sup>, Bayode A. Afolalu<sup>1</sup>, Usama T. Hussein<sup>1</sup>, Radu R. Raducu<sup>1</sup>, Amenuve M. Bekui<sup>1</sup> and Fredric O. Finkelstein<sup>1,2,3</sup>

<sup>1</sup>Yale New Haven Hospital, New Haven, CT, USA, <sup>2</sup>Yale University, New Haven, CT, USA and <sup>3</sup>Renal Research Institute, New Haven, CT, USA

Correspondence and offprint requests to: F. Finkelstein; E-mail: fof@comcast.net

### Abstract

**Background.** Patients maintained on hemodialysis (HD) have an impaired health-related quality of life (HRQOL). One factor that has been suggested to contribute to this impairment is the prolonged recovery time after completing a conventional HD session. The present study was designed to carefully examine the time to recovery (TTR) in patients maintained on three times/week conventional HD and evaluate the clinical and demographic features associated with the TTR.

**Methods.** Two hundred and sixty-seven patients on conventional three times/week HD were studied during three successive HD treatments. Patients were asked how long it took them to recover from their previous session. Detailed demographic and clinical data as well as data involving the most recent HD session were reviewed.

**Results.** The mean  $\pm$  SD age was  $66.4 \pm 15.7$  and the mean duration of renal replacement therapy was  $40.1 \pm 37.6$  months. The mean time to recovery was  $246 \pm 451$  min. A multivariate regression analysis including age, gender, number of comorbidities, months on renal replacement therapy, occurrence of hypotension during dialysis, amount of ultrafiltration and duration of dialysis session revealed that none of these covariates was significantly associated with TTR from HD.

**Conclusions.** The present study is important since it clarifies that the TTR after an HD session is not related to various demographic and clinical factors that one might have expected would impact on this variable.

**Keywords:** chronic kidney disease; end-stage renal disease; hemodialysis; quality of life of dialysis patients; time to recovery from dialysis

### Introduction

The impaired health-related quality of life (HRQOL) of patients with end-stage renal disease (ESRD) maintained on hemodialysis (HD) is well documented [1]. The reasons for this are multifactorial. One factor that has been suggested to contribute to this impaired HRQOL is the prolonged recovery time of patients after completing a short, conventional three times/week HD session [2, 3]. The question 'How long does it take to recover from a dialysis session?' is now recognized as a validated tool giving insight into patients' subjective experience of dialysis [2–5]. This prolonged recovery time has been associated with impairments of various HRQOL measures, including several subscales of the SF-36, Health Utilities Index, patient perception of fatigue and psychosocial stress [2, 3]. A significantly shortened time to recovery noted with more frequent short daily and nocturnal HD patients has been associated with improved HRQOL measures [2, 3, 5]. For example, recent reports underscore that there is a dramatically shortened time to recovery reported by patients who change to short, daily home HD from conventional three

times/week HD in association with an improvement in various HRQOL measures [5–7].

The sentinel study defining the importance of the recovery time examined only 45 patients undergoing various types of HD [3]. Whether the time to recovery is affected by various demographic patient characteristics, duration of dialysis and rate of ultrafiltration, however, is not clear. It is important to define which patient and dialysis treatment features are associated with the time to recovery if this question is to be used to assess newer dialysis treatment regimens and to better understand the relationship of this question to quality-of-life measures [1–5]. The present study was designed to carefully examine the time to recovery in a large cohort of HD patients maintained on conventional three times/week HD and examine the clinical and demographic features associated with the time to recovery.

### Materials and methods

The study was performed in four HD centers in the Greater New Haven area affiliated with Yale New Haven Hospital.

All the patients who spoke English, were able to respond appropriately to the question about time to recovery and had been maintained on HD for at least 3 months were included in the study. Two hundred and sixty-seven patients were identified and all agreed to participate; informed consent was obtained from all patients. These patients were all maintained on conventional three times/week in-center HD with blood flows up to 500 cc/min for arteriovenous grafts and arteriovenous fistula and 400 cc/min for catheters with dialysate flows of 1.5 times the blood flow rate [8]. Dialysis duration varied between 2.5 and 4.5 h, with the duration determined by targeting equilibrated KT/V urea of 1.2 Fresenius 2008K machines were used with Optiflux dialysers.

Time to recovery was defined by the question posed to patients, 'How long does it take you to recover from a dialysis session?' The protocol described by Lindsay et al. was used [2]; the times were converted into minutes using the following schema: answers given in minutes were recorded directly, answers in hours were multiplied by 60, variants of 'half a day', including the 'next day', were given a value of 720 min, variants of 'one day' were given a value of 1440 min, variants of 'more than a day' were given a value of 2160 min (36 h). Patients were asked about the time to recovery on three successive HD treatments.

Demographic and clinical data collected included age, gender, duration on renal replacement and comorbidities. The duration of HD, amount of fluid removed during the HD session and the presence or absence of hypotension (defined as systolic <90 or a decrease in systolic of 30 or more if the starting BP was 90 or less) were noted. The comorbidity scoring method used was modified from work by Davies et al. [9] and included reviewing the patient record for the diagnoses of congestive heart failure, diabetes, peripheral vascular disease, coronary artery disease, chronic obstructive pulmonary disease, malignancies and chronic liver disease. All units had three shifts: the first shift ran between 6 a.m. and 10:30 a.m., the second between 10:30 a.m. and 3:00 p.m., and third between 3:00 p.m. and 7:30 p.m. The shifts of all patients were noted.

To examine the relationship between TTR and various demographic and clinical data, univariate and bivariate analysis was done using means and *t*-tests for continuous data, the Chi-square and Fisher's exact test where appropriate for categorical variables. Pairwise Pearson correlation was done for time to recovery, time on hemodialysis and ultrafiltration volume at HD for each HD session. Multivariate linear regression was performed with time to recovery as dependent variable and age, gender, months on HD and number of comorbidities as covariates. In addition, correlations between time to recovery at each of the HD sessions were obtained as a measure of test-retest for the question 'How long does it take you to recover from a hemodialysis session?'. All statistical analysis was done using Stata version 9.2 (Stata Corp. University Station, TX, USA).

## Results

One hundred and forty-four males and 123 females were included in the study (Table 1). The demographic data for the patients were typical for the USA dialysis population, with patients having a mean age of  $66.4 \pm 15.7$  years and a mean dialysis duration of  $40.1 \pm 37.6$  months (Table 1).

**Table 1.** Demographics/characteristics

Age (mean $\pm$ SD years)	66.4 ( $\pm$ 15.7)
Mean duration of dialysis (months)	40.1 ( $\pm$ 37.6)
Mean number of co-morbidities	1.4( $\pm$ 0.9)
Male/female (%)	55%/45%
% Caucasian/African American/ Hispanic	54%/36%/10%
% With diabetes	45%

The mean TTR reported by patients was very similar on the three successive dialysis treatments (Table 2). The times to recovery in these sessions were  $246 \pm 451$ ,  $230 \pm 422$  and  $245 \pm 413$  min for sessions 1, 2 and 3, respectively. There was strong test-retest correlation between sessions [for sessions 1 and 2, Pearson's *r* 0.702 (95% CI: 0.63. -0.76,  $P < 0.00001$ ); sessions 2 and 3, Pearson's *r* 0.863 (95% CI: 0.823-0.894,  $P < 0.00001$ )].

In Table 2, the relationships between TTR and various demographic and clinical data as well as several dialysis parameters were examined. Importantly, no significant relationships were noted between age, gender, number of comorbidities, duration on renal replacement therapy the amount of ultrafiltration, the length of time of each HD session and the occurrence of hypotension during the dialysis session and the TTR at the two-sided 5% level. To further look at whether the amount of ultrafiltration or duration of HD treatment sessions was related to TTR, we did a Pearson's correlation coefficient which showed no significant associations.

## Discussion

The present study further characterizes and explores the factors associated with the prolonged time to recovery for patients maintained on three times/week conventional HD. The importance of this prolonged recovery time was emphasized in prior papers by Heidenheim et al. and Lindsay et al. [2, 3]. The study by Lindsay et al. of 2006 examined only 45 patients treated with various modalities of hemodialysis, including short daily, nocturnal and conventional HD. Importantly, that study demonstrated that the question 'How long does it take to recover from a dialysis session?' was easily understood by patients and that responses were stable over time with a high test-retest consistency.

The Lindsay et al. study also noted the associations of the prolonged recovery time with impairment of various HRQOL measures in the 45 patients studied. These associations emphasized the convergent construct validity of the time to recovery question since the question had statistically significant relationships with various variables that relate to the burden of dialysis. Similarly, divergent construct validity was established in this study in view of the lack of association of responses to the time to recovery question and other variables (such as several questions on the Health Utilities Index) that appear not to be related to problems associated with dialysis.

In addition, these authors stressed the marked decrease in recovery time associated with more frequent HD compared with conventional, three times/week HD. This is particularly important as investigators begin to explore the potential benefits of newer dialysis treatment regimens. Thus, it is now recognized that in the assessment of the change in dialysis regimens, the time to recovery is an important measure to consider and has been included as

**Table 2.** Multiple regression with time to recovery (minutes) as a dependent variable

	Coefficient	Std. Err.	t	P > t	(95% Conf. interval)
Age (years)	0.1047136	1.96288	0.05	0.957	-3.760663-3.97009
Gender (male as base)	57.56284	56.02804	1.03	0.305	-52.76967-167.8954
Comorbidities (number)	-19.62201	31.97779	-0.61	0.54	-82.59387-43.34985
Hemodialysis duration (months)	0.1834174	0.721073	0.25	0.799	-1.236547-- 1.603381
Ultrafiltrate volume (mL)	12.47783	24.69789	0.51	0.614	-36.15818-61.11383
Duration of hemodialysis session (min)	-0.7749487	0.6645815	-1.17	0.245	-2.083668-0.5337701
Episode of hypotension (yes/no)	30.74984	86.19564	0.36	0.722	-138.9898-200.4895
Constant	353.7672	211.3135	1.67	0.095	-62.35921-769.8936

an outcome measure in clinical trials of more frequent HD [4, 5]. In fact, a recent report from the FREEDOM (Following Rehabilitation, Economics and Everyday-Dialysis Outcome Measurements) study indicated that changing patients from conventional HD to short daily HD results in a dramatic shortening of the time to recovery; the time to recovery decreased from 476 to 63 min [5].

Thus, it is important to better characterize those factors associated with time to recovery in patients maintained on conventional HD since the time to recovery is being considered a valid outcome measure of newer dialysis treatment regimens. The present study looks at 267 patients maintained on conventional in-centre three times/week. The results are important since a large number of patients have been studied and the findings help characterize those factors that might impact on the time to recovery of patients maintained on conventional HD treatment regimens. It is perhaps surprising, then, that the time to recovery was not affected by patient age, duration of chronic dialysis, amount of ultrafiltration, presence of hypotension or the length of the dialysis treatment. We have no clear explanation why these associations were not seen, but the findings suggest that the time to recovery is independent of these variables. The lack of association with co-morbidities is perhaps not so surprising since we did not assess the severity or acuity of the co-morbidities but simply noted their presence or absence. Interestingly, the lack of association of time to recovery with co-morbidities was also noted in a study of 100 HD patients in Italy [10].

The lack of association of time to recovery with the variables analyzed is important to keep in mind as we advise patients about modality selection and choice and involve patients in shared decision-making about their care. We need to counsel patients that it is difficult to predict the time to recovery after a dialysis session based on standard demographic and clinical features. For example, increased age and the presence of co-morbidities do not put patients at greater risk of having a prolonged time to recovery. Similarly, the amount of ultrafiltration and duration of the conventional HD session do not predict the time to recovery.

The impact of TTR on other HRQOL measures is of interest and needs additional exploration. This was pointed out clearly in the Lindsay study where a strong association was noted, for example, between all domains of the SF-36 and the time to recovery [3]. The association with HRQOL was further noted in a study by Bossola *et al.* [10]. These authors noted a significant association between time to recovery and both fatigue and depressive symptoms [10]. Interestingly, various co-morbidities were not independently associated with TTR in this study [10], similar to the findings noted in the present study.

In conclusion, the time to recovery after a dialysis session has been included as an outcome measure in trials evaluating the impact of modifications in the

dialysis treatment regimen [2, 3, 5]. Recent studies have suggested that such modifications in treatment can impact on the time to recovery and these changes may be associated with improvements in various HRQOL measures [2, 3, 5, 8]. The present study helps clarify those factors that impact on the time to recovery after a conventional three times week HD session. Those factors which might have been expected to effect the time to recovery (such as patient age, duration of dialysis, occurrence of hypotension, amount of ultrafiltration, etc.) do not appear to impact on the recovery time. Would a change in dialysis have any effect on the time to recovery after a dialysis session? If so, would these changes be associated with an improvement in HRQOL measures? Data that is available suggest that patients on more frequent and long duration nocturnal HD have a much shorter time to recovery [2, 3]. And data from the FREEDOM study suggests that patients changing from conventional HD to six times/week home HD have a dramatic shortening of the TTR [5]. Additionally, the FREEDOM study suggests that changing to six times/week from conventional in-center HD results in a dramatic improvement in various HRQOL measures [5-7]. The extent to which the improved HRQOL relates to the shortening in the TTR remains to be explored in a large cohort of ESRD patients.

*Conflict of interest statement.* None declared.

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