

LETTER TO THE EDITOR

Feasibility of long-term twice-weekly hemodialysis during the Covid-19 pandemic

To the Editor

As the pandemic continues to rage in many developing countries, the saving of material and staff resources is a major priority in these resource-limited settings. The option of reducing the usual thrice-weekly session schedule to a twice-weekly one has been advocated by some authors¹ but rejected by others.² Different proposals to implement a twice-weekly schedule in selected hemodialysis (HD) patients were recently published, from practical step-wise approaches based mainly in the ultrafiltration rate (UFR)^{3,4} to a detailed framework.⁵ However, only the Kt/V_{urea} was suggested to measure dialysis adequacy. If a long-term twice-weekly schedule is necessary, an equivalent continuous clearance should be estimated at regular intervals to certify that an adequate HD dose is delivered. In patients who reach and sustain a minimum HD dose,⁶ a long-term twice-weekly schedule would be a safe option during the COVID-19 pandemic. Our aim was to evaluate the percentage of patients that could achieve the minimum target and would therefore be suitable for safe, long-term, twice-weekly HD.

This study was performed in accordance with the Declaration of Helsinki. Average data from the first semester of 2021 were extracted from deidentified patients undergoing thrice-weekly HD. Twenty-four-hour urine and blood samples were processed in local laboratories using automated and standardized methods. Urea kinetics analysis was performed using Solute-Solver,⁷ version 2.14. Solute-Solver is a web-based urea kinetic

modelling software that enables urea modelling in patients dialyzing from 1 to 7 sessions a week. A twice-weekly schedule was simulated in all patients. Solute-Solver estimates two variants of an equivalent continuous clearance: the standard fractional urea clearance in volumes per week (stdKt/V) and the equivalent renal urea clearance in ml/min (EKRU).

The characteristics of the 110 patients included have been described previously.³ Mean $\text{spKt/V}_{\text{urea}}$ was 1.60 (SD: 0.38). The left column of Table 1 shows the major parameters of the anuric patients and the right column shows those of patients with a diuresis of at least 200 ml/day. With the exception of the double-pool equilibrated Kt/V_{urea} (eKt/V), this group performed better in all parameters. The group comprised 36 patients (33%) with a median daily urine output of 956 ml/day (interquartile range: 622–1300). The median ultrafiltration rate (UFR) of these 36 patients was 4.9 ml/kg/h (interquartile range 2.9–9.0). This UFR is below the upper limit of 13 ml/kg/h that has been set by many dialysis providers and below the recently proposed upper limit of 8.5 ml/kg/h.³ However, only those with a diuresis >519 ml/day ($n = 24$, 22%) reached the minimum dose⁶ of 2.1 stdKt/V —Figure 1a. This minimum dose has been proposed by the 2015 update of National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines.⁶ However, to be sure that the minimum dose is delivered a target of 2.3 stdKt/V has been suggested by these guidelines. Figure 1b shows the estimated eKt/V

TABLE 1 Major kinetic parameters

	Anuric ($n = 74$)	Diuresis >200 ml/day ($n = 36$)	<i>p</i> -value
eqKt/V	1.49 (1.26–1.72)	1.30 (1.03–1.50)	0.002
stdKt/V	1.70 (1.54–1.86)	2.25 (1.95–2.69)	0.000
SAN_stdKt/V	1.69 (1.54–1.86)	2.26 (1.94–2.74)	0.000
EKRU(ml/min)	7.44 (6.76–7.90)	9.36 (8.4–10.5)	0.000

Note: Data are presented as median and (interquartile range). Comparisons were made using the nonparametric Wilcoxon test. Kinetic parameters of a simulated twice-weekly schedule were estimated using the web-based Solute Solver version 2.14 software.⁷ Of the 36 patients with residual kidney function, 24 (22% of the whole sample) reached the minimum dose in stdKt/V suggested by the 2015 updated KDOQI guidelines.⁶

Abbreviations: EKRU, equivalent renal urea clearance in ml/min; eKt/V , double-pool equilibrated urea clearance; SAN_stdKt/V , surface area normalized stdKt/V ; stdKt/V , fractional urea clearance in volumes per week.

required in each session to achieve the 2.3 stdKt/V target. Alternatively, a minimum session time can also be estimated (Figure 1c).

Patients participating in a long-term twice-weekly schedule need careful monitoring. Based on the results of the present study, we wish to suggest the following framework. Initially, urea kinetic modelling should be determined in all patients with a diuresis higher than 500 ml/day. Then, modelling should be determined at least quarterly. In the meantime, in those patients who fulfilled the minimum target, 24-h urine volume should be measured frequently. Alternatively, the modelled eKt/V could be estimated from the Kt/V measured online by contemporary dialysis machines.¹⁰ If the HD machines do not provide this technology, one may prescribe the session time estimated by the mobile app.⁹ In addition to the adequacy,

other clinical parameters might be considered, such as ultrafiltration rate, hyperkalemia, nutritional status, anemia and hyperphosphatemia.^{3,4} We recognize that this framework may increase workload, but this should be balanced by the saving of valuable and limited material and staff resources.

The small sample of the present study limits its external validity. Nevertheless, it provides support for the notion that selected patients could be safely transferred to a long-term twice-weekly schedule during the COVID-19 pandemic. A sizeable percentage of our HD patients (24 out of 110: 22%), would be suitable for a long-term twice-weekly schedule. This represents 96 HD sessions/month and these resources could be reallocated to serve the increasing acute dialysis needs during the COVID-19 pandemic.

CONFLICT OF INTEREST

None of the authors had any financial or personal relations with people or organizations that could have inappropriately influenced their work. Funding was provided by each dialysis unit. The corresponding author states that he had full access to all the data in the study and

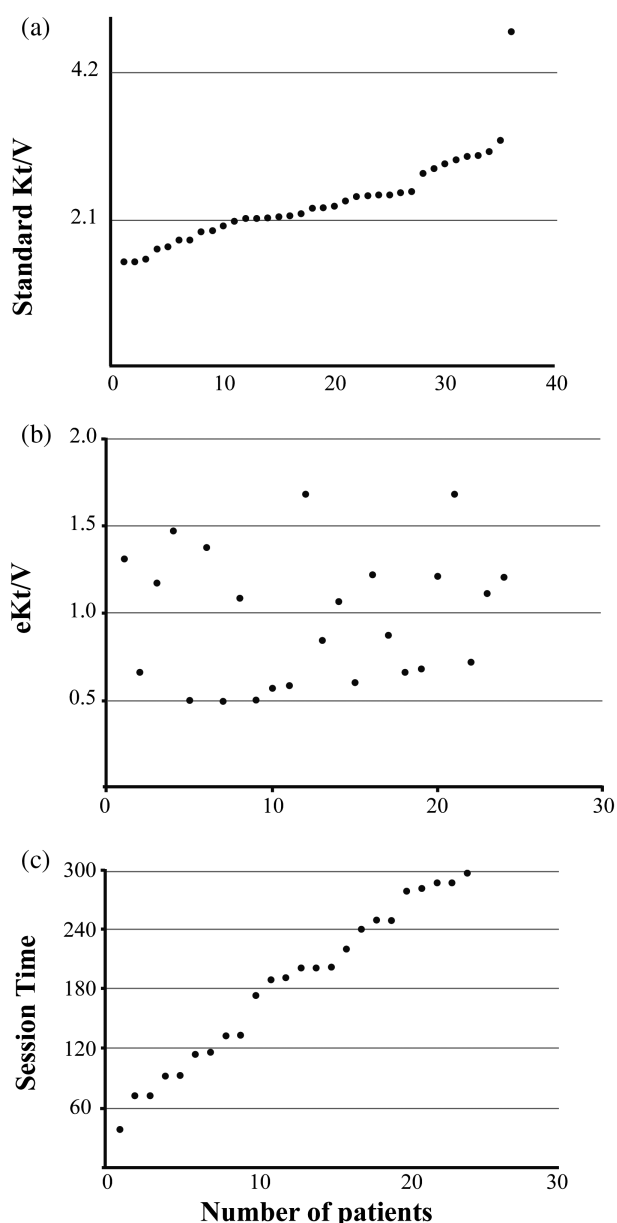


FIGURE 1 Feasibility of twice-weekly hemodialysis (HD) in patients with residual kidney function. Vertical axis on scatter Plot **1a** represents stdKt/V, standard fractional urea clearance in volumes per week. On Plot **1b** vertical axis represents eKt/V, double-pool equilibrated Kt/V_{urea} and on Plot **1c** time of one HD session in minutes. Number of patients is presented on the horizontal axis of the three plots. The stdKt/V - estimated with Solute-Solver⁷ version 2.14 - of 36 patients with a diuresis of at least 200 ml/day is depicted in Plot **1a**. Twenty four reached the guidelines⁶ proposed minimum dose of 2.1. This represents 22% of the total sample ($n = 110$) who would be suitable for a twice-weekly schedule. In Plot **1b**, only 24 patients who reached the minimum dose are depicted. Using the spreadsheet Speedy,⁸ we estimate the eKt/V needed in each session for these 24 patients to achieve an stdKt/V target⁶ of 2.3 volumes per week. All but two patients needed an eKt/V lower than 1.5 to reach the target. Speedy also estimates an equivalent renal urea clearance normalized to 35 ml of body water (EKRun). Using this metric, the number of patients suitable for twice-weekly HD would increase from 24 to 29. To the best of our knowledge, controlled evidence supporting either EKRun or stdKt/V as a guide for HD prescription is still missing. The current guidelines adopt stdKt/V to determine dialysis dose. Plot **1c** shows the estimated session time required for these 24 patients to reach the 2.3 stdKt/V target. For all except five patients, a session time of 240 min was sufficient to reach the target. Time in minutes was estimated with a recently developed⁹ mobile phone application: stdKtV calculator for iOS and stdKt/V calculator for Android

had final responsibility for the decision to submit for publication.

DATA AVAILABILITY STATEMENT

Data are available on request.

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