Twardowski ZJ.


Chronic hemodialysis sessions, as developed in the early 1960s, were long procedures with minimal intra- and inter-dialytic symptoms. Over the next three decades, financial and logistical pressures related to the overwhelming number of patients requiring hemodialysis created an incentive to shorten dialysis time to four, three, and even two hours per session in a thrice weekly schedule. This method spread rapidly, particularly in the United States, after the National Cooperative Dialysis Study suggested that time of dialysis is of minor importance as long as urea clearance multiplied by dialysis time and scaled to total body water (Kt/V\textsubscript{urea}) equals 0.95-1.0. This number was later increased to 1.3, but the assumption that hemodialysis time is of minimal importance, as long as it is compensated by increased urea clearance, remained unchanged. Patients accepted short dialysis as a godsend, believing that it would not be detrimental to their well-being and longevity.

However, Kt/V\textsubscript{urea} measures only removal of urea, which is relatively non-toxic. This yardstick does not correlate with removal of larger molecules. Larger molecules, including phosphates, transfer slowly between various body compartments and their removal depends more on time and frequency of hemodialysis than on blood and dialysate flows in the dialyzer. Moreover, Kt/V\textsubscript{urea} does not correlate with the other important function of hemodialysis, namely, ultrafiltration. Whereas patients with substantial residual renal function may tolerate short dialysis sessions, patients with little or no urine output tolerate short dialyses poorly because at a given interdialytic weight gain the ultrafiltration rate is inversely proportional to dialysis time. Rapid ultrafiltration is associated with cramps, nausea, vomiting, headache, fatigue, hypotensive episodes during dialysis, and hangover after dialysis; patients remain fluid-overloaded with subsequent poor blood pressure control leading to left ventricular hypertrophy, diastolic dysfunction, and high cardiovascular mortality.

Short, high-efficiency dialysis requires high blood flow, which increases demands on blood access. The classic, forearm arterio-venous fistula, the access with the best longevity and lowest complication rates, provides “insufficient” blood flow and is replaced with an arterio-venous graft fistula or an intravenous catheter. Moreover, to achieve high blood flows, large-diameter intravenous catheters are used; these fit veins “too tightly” and so predispose to central-vein thrombosis and stenosis.

Longer hemodialysis sessions (5–8 hrs, thrice weekly), as practiced in some centers, are associated with lower complication rates and better outcomes. Frequent dialyses (four or more sessions per week) with total weekly dialysis time sufficient to allow gentle ultrafiltration rates provide the best clinical results, but are associated with increased costs which are not properly reimbursed in the USA at present. Therefore, it is my strong belief that before a more appropriate reimbursement scheme is available, a wide acceptance of longer, gentler dialysis sessions, in the current thrice weekly schedule, would improve
overall hemodialysis results, decrease access complications, hospitalizations and mortality, particularly in the patients with no or very little residual renal function.

Kt/\text{V}_{\text{urea}}$ should be abandoned as a measure of dialysis quality. The formula suggests that it is possible to decrease “$t$” as long as “$K$” is proportionately increased, but this concept is not true. The use of rigid, quantitative guidelines (e.g., spKt/V$_{\text{urea}}$ of 1.3 per dialysis) assumes that all patients behave identically in response to therapeutic maneuvers, like the mean of the group, but this idea is also not true. The individual, clinical approach assumes that there are differences among patients, which require adjustment of dialysis schedule for each patient. Patients’ clinical symptoms are a better guidance of dialysis quality than rigid numbers. These numbers are helpful, but can never replace clinical judgment. If quality of dialysis could be judged by rigid formulas, nephrologists would not be needed in dialysis centers—computer programs and dialysis technicians would suffice.

**Commentary by Todd S. Ing, MD**

A lot of Dr. Twardowski's remarks make sense. Many aspects of dialysis treatments such as fluid control, blood pressure control, acid-base balance, calcium and phosphorus regulation, anemia management, symptoms occurring during and after dialysis, sense of well-being, appetite level, nutrition state, sleep pattern and etc. should also be emphasized. Kt/V is not the ideal solution and a better yardstick is being awaited. However, the adoption of a minimal Kt/V standard of 1.2 per session for the thrice weekly dialysis regimen has, at least, eliminated those grossly inadequate dialysis treatments with Kt/V values much less than 1.2 from the scene. Dr. Twardowski is correct to state that many of the problems associated with thrice weekly dialyses can be improved by employing more prolonged and/or more frequent dialysis sessions.