

# Use of Systemic Blood Urea Nitrogen Levels Obtained 30 Minutes before the End of Hemodialysis to Portray Equilibrated, Postdialysis Blood Urea Nitrogen Values

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*Blood urea nitrogen (BUN) levels obtained at 30 minutes before the end of dialysis were found to be closely similar to equilibrated, postdialysis BUN values obtained 30 minutes after the end of dialysis. Because of this similarity, the former BUN values can be used to derive equilibrated urea reduction ratio, or equilibrated Kt/V instead.*

*(Hemodial Int, Vol. 4, 15–17, 2000)*

## Key words

Kt/V, equilibrated BUN, urea reduction ratio, urea rebound

## Introduction

Urea rebound refers to an early postdialysis phenomenon in which urea returns to the systemic circulation, raising the blood level to a near plateau over a period of 0.5 to 1 hour [1]. The urea involved is believed to have come from either the intracellular compartment by means of diffusion resulting from the dialysis-induced concentration gradient [2,3], or tissues poorly perfused as a result of a dialysis-induced vasoconstriction [4].

Because of urea rebound, blood urea nitrogen (BUN) levels of systemic blood samples obtained 30 minutes after the completion of a hemodialysis treatment (+30-min BUN) are higher than those collected promptly after a dialysis session is over [1,5–11]. Recently, however, it has been shown that the BUN concentrations of systemic blood specimens obtained 30 minutes prior to the end of a dialysis session (–30-min BUN) are similar in value to their 30-minute postdialysis (+30-min BUN) counterparts [12,13]. In an attempt to determine whether such a relationship between BUN concentrations exists in patients dialyzed six times per week, as well as in those dialyzed three-times weekly, the present study was carried out. Preliminary results have been reported previously [14].

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## Materials and methods

We collected “–30-min BUN” and “+30-min BUN” blood samples during 146 dialysis treatments in 20 maintenance hemodialysis patients at 6 dialysis centers. Of the 146 sessions, 74 were three-times-weekly, 4-hour treatments, while the remaining 72 were 6-times-weekly, 2-hour treatments. The blood samples from which “–30-min BUN” levels were determined were obtained from the proximal blood sampling port of the arterial blood tubing after the blood pump speed had been reduced to 100 mL/min for 15 seconds, in accordance with Dialysis Outcomes Quality Initiative (DOQI) guidelines (this maneuver avoids sampling of access recirculation-contaminated blood) [11]. Blood specimens required for the “+30-min BUN” values were obtained from the arterial needle tubing without contamination by saline or heparin. BUN values were measured by the routine chemical methods in use at the participating centers.

We calculated the differences between “–30-min BUN” and “+30-min BUN” concentrations, and the (“–30-min BUN”)/ (“+30-min BUN”) ratios. We also studied five factors (BUN decline/hour of dialysis, predialysis serum potassium level, duration of dialysis, ultrafiltration rate, and magnitude of urea rebound) that could influence the above-mentioned differences and ratios.

## Results

The mean “–30-min BUN” level was  $24.5 \pm 10.6$  (SD) mg/dL, and the mean “+30-min BUN” value,  $25.0 \pm 10.8$  mg/dL. There was excellent overall agreement between the “–30-min BUN” and the “+30-min BUN” concentrations, with the regression coefficient being 0.987,  $p < 0.0001$  (Fig. 1). The mean (“–30-min BUN” – “+30-min BUN”) difference was  $0.55 \pm 1.75$  mg/dL, and the mean (“–30-min BUN”)/ (“+30-min BUN”) ratio,  $0.98 \pm 0.09$ . In only 2 patients was the (“–30-min BUN” – “+30-min BUN”) value larger than 1.5 mg/dL and the deviation from unity of the (“–30-min BUN”)/ (“+30-min BUN”) ratio greater than 0.07. Those 2 patients could not be differentiated from the rest by age, sex, race, or dialysis history.

In the present study, using the above (“–30-min BUN”) – (“+30-min BUN”) and the (“–30-min BUN”)/ (“+30-min

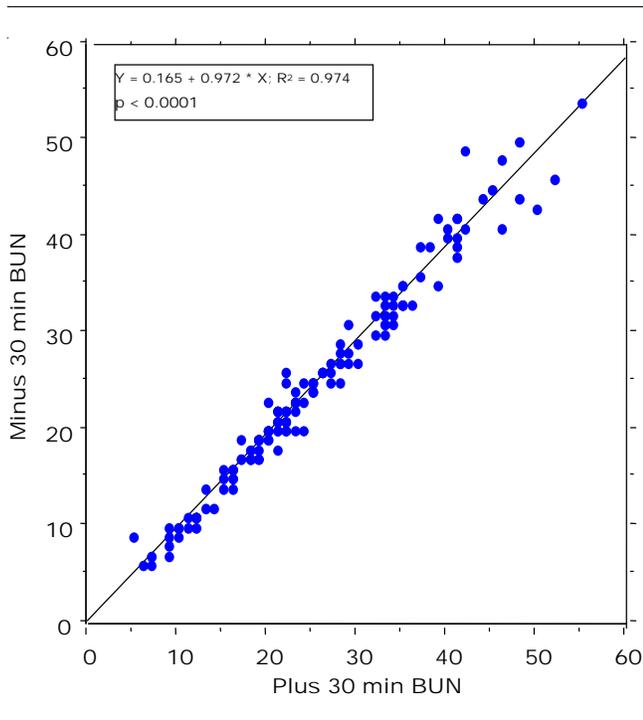


FIGURE 1 Correlation between “+30-minute BUN” and “-30-minute BUN” concentrations.

BUN”) data, one could not differentiate between patients who were receiving three-times weekly treatments and those who were being dialyzed six times weekly. In all the patients, the mean differences and the mean ratios had no correlation with predialysis serum potassium value, duration of dialysis, ultrafiltration rate, or magnitude of urea rebound. Patients whose BUN decline per hour was higher than 25 mg/dL tended to have higher BUN values at +30 minutes than at -30 minutes.

### Discussion

Because of urea rebound, an equilibrated, postdialysis BUN concentration is a much more precise and representative gauge of the BUN level in the body’s urea distribution volume than a single-pool, postdialysis BUN value [11]. Ordinarily, an equilibrated, postdialysis BUN level is best obtained by collecting the blood sample 30 minutes after the completion of a dialysis treatment, that is, after urea rebound has taken place [1,10,11]. However, under ordinary circumstances it is often difficult to keep patients for an extra 30 minutes postdialysis merely for blood to be obtained for the determination of equilibrated BUN concentrations.

The results in the present study lend support to the findings of Canaud *et al.* [12] and those of Bhaskaran *et al.* [13] that “-30-min BUN” and “+30-min BUN” values are similar. Because of this similarity, one can use the “-30-min BUN” level instead of the “+30-min BUN” value to represent equilibrated, postdialysis BUN concentrations and to compute, for example, the equilibrated urea reduction ratio [15] or the equilibrated Kt/V value [12,13]. As a result of

this advantage, there is no need for patients to spend time waiting for blood to be drawn for the measurement of “+30-min BUN” values.

It should be noted that, in the present study, when the BUN decline was more steep than 25 mg/dL per hour, the “+30-min BUN” value tended to be higher than the “-30-min BUN” counterpart. Such a finding came as no surprise since it is well known that urea rebound is greater if a dialysis treatment is more efficient [6]. In the face of efficient dialysis sessions, it is conceivable that one should obtain blood samples at a time slightly earlier than -30 minutes. Apart from using “+30-min BUN” or “-30-min BUN” concentrations to depict equilibrated, postdialysis BUN levels, other methods have also been devised to achieve the same purpose, such as the use of mathematical formulas. The formulas currently available all require at least an immediate postdialysis (e.g., 15-second) BUN concentration for their computation [7–10]. Although it has been suggested that some of the formulas used do provide results that approximate those derived from “+30-min BUN” values [10], the present “-30-min BUN” method does offer a simpler alternative approach for a good approximation of equilibrated, postdialysis BUN levels.

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