Accuracy of Urinary Urea Nitrogen for Predicting Total Urinary Nitrogen in Thermally Injured Patients*

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ABSTRACT. Estimations of total urinary nitrogen from measured urinary urea nitrogen are commonly used in calculating nitrogen balance. Recently published studies suggest the urinary urea nitrogen/total urinary nitrogen relationship is inconstant and total urinary nitrogen must be directly measured in burned patients. This study addresses the relationship of urinary urea nitrogen to total urinary nitrogen after thermal injury. Two hundred random 24-hour urine collections obtained from 45 thermally injured patients (mean burn size 59 ± 28%, mean age 40.6 ± 17.2 years) between 1 and 364 days postburn were analyzed for total urinary nitrogen and urinary urea nitrogen. Regression analysis relating total urinary nitrogen to estimated total urinary nitrogen (urinary urea nitrogen × 1.25) revealed a linear relationship (r = 0.936, p < .001). The mean urinary urea nitrogen/total urinary nitrogen ratio was 0.77 ± 0.10 and was not significantly correlated with percent burn, age, or postburn day. Mean nitrogen balance calculated from measured urinary urea nitrogen in these patients was –6.7 g, and that calculated from measured total urinary nitrogen was –6.3 g. This difference, although statistically significant, is of little consequence for clinical use. Contrary to recent reports, we found the urinary urea nitrogen to be sufficiently predictive of total urinary nitrogen for practical application, and do not currently recommend routine total urinary nitrogen measurements necessary for the nutritional care of thermally injured patients. (Journal of Parenteral and Enteral Nutrition 17:414–416, 1993)
MATERIALS AND METHODS

Forty-five thermally injured patients admitted to this burn facility between June 1 and September 1992 had random 24-hour urine collections (n = 200) analyzed for UUN and TUN as part of routine nutrition assessment. Adult patients in the intensive care unit who had indwelling urinary catheters were included in this study. Patients with hepatic or renal dysfunction were excluded. The demographic characteristics of these patients are summarized in Table I. Samples were obtained between 1 and 364 days after injury. UUN was analyzed by a coupled urease procedure (IL Monarch, Lexington, MA) and TUN by chemoluminescence (Antek Instruments, Houston, TX).

Estimated nitrogen intake included all intravenous, enteral, and oral sources, weighed and measured to the nearest milliliter, and/or gram. Nitrogen loss by way of wound exudation was estimated according to a formula derived by Waxman et al. on the basis of the percent of open wound. In calculating nitrogen balances on the basis of UUN, predicted TUN was estimated by multiplying UUN by 1.25 to account for the nonurea component of urinary nitrogen. Fecal nitrogen loss was estimated as 2 g/d in all patients.

Regression analysis was used to evaluate the relationship between TUN and predicted TUN, and to evaluate the relationship between the UUN:TUN ratio and burn size, age, and postburn day. A paired t test was used to evaluate the difference between nitrogen balance calculated from UUN and that calculated from TUN.

RESULTS

The UUN and TUN results are summarized in Table II (n = 200). Regression analysis relating TUN to predicted TUN (UUN x 1.25) revealed a linear relationship (r = 0.936, p < .001) (Fig. 1). The mean difference between measured TUN and predicted TUN was 0.68 ± 2.4 g. The mean UUN:TUN ratio was 0.77 ± 0.10 and was not significantly correlated with percent burn, age, or postburn day.

A regression analysis relating nitrogen balance calculated from UUN to that calculated from TUN revealed a strong linear relationship (r = 0.980, p < .001) (Fig. 2). The mean nitrogen balance calculated from UUN was

-5.7 ± 12.2 g, and that calculated from measured TUN was -6.3 ± 12.6 g. This difference was statistically significant (p < .001, paired t test).

DISCUSSION

The limitations inherent in estimations of nitrogen balance must be considered in interpreting this study. All such studies are susceptible to errors in collection, in measurement, and in estimation of dietary nitrogen. In addition, high protein intake and/or high blood urea nitrogen may result in misleading analyses of nitrogen balance. Stool losses of nitrogen do vary, especially in patients with diarrhea, but are rarely measured. Burned patients sustain additional nitrogen losses through their open wounds; these, too, are usually estimated and not measured, because collection of wound exudate is often impractical.

Despite these limitations, nitrogen balance studies are widely accepted as a "gold standard" for nutrition assessment in thermally injured patients. Although not an exact indicator of nutritional adequacy, they offer a general guideline for nutrition support when used in conjunction with other variables such as weight and the relationship between caloric intake and measured or estimated caloric requirement. Although the mean nitrogen balances calculated from UUN and TUN in these patients differed statistically, the mean difference...
Patient data (>7 g discrepancy in N balance)

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (y)</th>
<th>Sex</th>
<th>% Burn</th>
<th>BSA (m²)</th>
<th>Postburn day</th>
<th>N balance</th>
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</table>

N, nitrogen; BSA, body surface area; UUN, urinary area nitrogen; TUN, total urinary nitrogen.

of 0.6 g is clinically irrelevant and did not alter nutrition therapy in these patients.

Occasional outliers were observed in these 200 determinations. Six nitrogen balance studies showed a difference of more than 7 g between calculations made on the basis of UUN and those made on the basis of TUN, the balance being more negative with TUN. These differences, which occurred in six different patients, all of whom survived, are summarized in Table III. In these patients, differences between 0 and 7 g were observed in the week before and the week after the studies listed in Table III, suggesting possible measurement error in the week in question.

Estimations of TUN made on the basis of UUN occasionally differ widely from direct measurements of TUN. This is anticipated, because both measurements are susceptible to error, and does not mandate direct measurement of TUN. The differences observed in this study between nitrogen balance calculations made on the basis of UUN and those made on the basis of directly measured TUN were statistically significant, but were too small to justify alteration of any nutrition support regimen and are therefore considered clinically irrelevant. Contrary to recently published reports, the results of this study do not justify routine measurement of TUN for postburn nitrogen balance studies. Although recent technology has made direct TUN analysis less expensive, less hazardous, and less time consuming than previous procedures, it is still more expensive and less accessible than UUN analysis, which is available in most clinical settings. UUN results are available almost immediately as compared with direct TUN results, which may take longer to obtain. Accessibility, lower cost, and satisfactory accuracy make UUN a more practical approach to the nutrition assessment and treatment of burned patients.

REFERENCES