DAILY PARTITION OF URINARY NITROGEN AND NITROGEN BALANCE DURING TREATMENT OF PROTEIN-DEPLETED INFANTS*

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Urinary nitrogen was first partitioned into 5 components in 1905 by Otto Folin.[1,2] From this early study of a human subject maintained on a constant diet for 1 week, Folin derived his concept that nitrogen metabolism was made up of exogenous and endogenous aspects. Greater understanding of methodology and an intense interest in the metabolism of various syndromes have made similar investigations under various conditions periodically necessary and informative. The purpose of the present investigation† is to correlate nutritional status with changes in various urinary nitrogenous constituents.

Partition of urinary nitrogen into 7 components and complete nitrogen balance was conducted daily throughout the repletion of 6 infants with kwashiorkor. After receiving electrolyte therapy for the first 12 - 24 hours, the infants were put on milk diets. Three of them received milk *ad lib.* and 3 received a lesser amount of milk for 10 days, followed by an isonitrogenous substitution of maize. We were unable to distinguish a difference in the urinary constituents when maize was substituted isonitrogenously for milk in these 3 infants as long as we corrected for the difference in absorption. Therefore the diet for these infants has been referred to as a low-protein diet. Urine from a healthy, active child living in a home environment was also collected for 2 weeks and partitioned.

The question as to what is the best expression of particular data is often a very perplexing one. This is especially true when the subjects are heterogeneous by certain criteria and/or are in an especially dynamic state. We have attempted to express our data in such a way as to reflect possible shifts in metabolism which might occur during the repletion of protein-depleted infants.

Urea(mg./absorbed nitrogen/day). The excretion of urea was low in our protein-depleted infants as expected. The effect

* Abstract of a paper presented at Research Forum, University of Cape Town, 18 May 1960.

† This study was part of the programme of the Clinical Nutrition Research Unit supported in the Department of Medicine by grants from the South African Council for Scientific and Industrial Research; the Williams Waterman Fund for the Combat of Dietary Diseases, Research Corporation, New York, USA; the Food and Nutrition Board, National Research Council, USA; and the Archibald R. Richardson Research Fund, Cape Town.

of increasing nitrogen intake on urea excretion was also clearly demonstrated. There was a tenfold increase in excretion by infants receiving milk *ad lib.* compared with no change in those receiving the low-protein diet. When the difference in intake as well as absorption was corrected for by using the expression percentage of absorbed nitrogen, the increase in urea excretion with treatment was much more uniform for all 6 of the infants. This twofold increase in urea excretion was probably a better reflection of the increased turnover rate of protein metabolism which would be associated with repletion.

Ammonia(mg./day). There was no apparent change in ammonia excretion by these infants from the second day of hospitalization (after electrolyte therapy) until cure was judged to be initiated.

Amino-acids(mg./mg. urinary creatinine/day; mg./absorbed nitrogen/day). These data clearly demonstrated the development and recession of the increased amino-aciduria which we have previously reported [3,4] during the treatment of infants with kwashiorkor. The effect of nitrogen intake on excretion was confirmed and demonstrated the need for expressing such data as a function of absorbed nitrogen.

Uric acid(mg./day). The excretion of uric acid in both groups increased significantly during repletion.

Creatinine(mg./day). Difference in creatinine excretion between the 2 groups of infants receiving the high and low protein intakes was apparent within 10 days. This difference probably reflected the difference in the rate of accumulation of muscle mass by the 2 groups.

Creatine(mg./day). Creatine excretion increased markedly in the infants receiving milk *ad lib.* The decrease in excretion by 1 of these infants to admission levels occurred several days before signs of a concurrent infection were recorded. Creatine excretion fell uniformly in the infants receiving the low-protein diet.

Undetermined nitrogen(mg./day). The urinary excretion of 'undetermined' nitrogen was understandably irregular since it was estimated by difference and thereby reflected the irregularities and error in the estimation of the 7 other nitrogenous components. There was a significant increase in the absolute excretion by those infants with the high-protein intake.

Nitrogen retention(mg./absorbed nitrogen/day). These observations on continuous nitrogen balance clearly illustrated several of the principles discussed in a recent publication [5] on balance studies conducted in our unit. For example, the mean retention was greater during the first few days of treatment (approximately 65% of absorbed nitrogen) and became less as repletion continued (approximately 20% of absorbed nitrogen after 2 weeks of treatment). It also appeared, in these subjects at least, that the day-to-day variation in nitrogen retention could be accounted for almost entirely on the basis of stage of depletion, and variation in absorption and/or intake.

SUMMARY

Basic data on nitrogen retention and the excretion of various end-products of nitrogen metabolism have been accumulated continuously throughout the treatment of infants with kwashiorkor. These data reflect the degree of protein deficiency in the infants and the quantitative differences in the dietary protein and/or absorption. Qualitative differences in dietary protein however, were not demonstrated in this series.

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