Invited Lecture

LOW NITROGEN DIET IN SEVERE CHRONIC URAEMIA; CLINICAL EXPERIENCE OF 18 MONTHS DURATION

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One of the main purposes of diet in chronic uraemia is to reduce to a minimum the production and, consequently, the retention of protein catabolites which are generally believed to be toxic, and, at the same time, to prevent a progressive depletion of the body proteins. The diet must be, therefore, of high calorie and low protein content, and these proteins should be of high biological value. A high calorie intake will prevent the wastage of body proteins, while proteins of high biological value, supply, with the least possible nitrogen, the aminoacids which are inevitably destroyed in metabolic processes.

But, it is almost impossible to give a high calorie diet, in the form of natural foods, without giving an excess of protein (Figure 1). In the past, attempts to overcome this obstacle have been made by giving sugar and fats, but, in our experience at least, such diet is not tolerated by patients.

In the present communication I will describe the attempts we have made to prepare high calorie foods with as low a protein content as possible, but with the taste and other properties similar to those of natural foods. The results obtained in 34 chronic uraemic patients, taking this diet, will be reported.

The main sources of calories in our diet are: starch, butter, unsalted lard, vegetable oils, sugar, honey and jams, but several fruits and vegetables, selected from those containing the least nitrogen, are used to make the diet as varied as possible.

Bread is prepared with a special wheat starch and small amounts of yeast, this bread contains about 1 g. % of protein, almost all of high biological value, whereas natural bread contains about 9 g. % of protein of low biological value. Wafers and spaghetti are prepared with tapioca starch and vegetable fats and are almost protein-free (less than 0.5 g.%), whereas the usual spaghetti contains about 13 g.% of protein.

This diet, which we called the basal protein-deficient diet (B.P.D. diet) contains 4 to 8 g. of protein (3 of which are from fruit and vegetables), about 15mEq of sodium and about 20mEq of potassium. Its caloric value ranges from 1800 to 2500 calories a day.

For dietary nitrogen we have used egg proteins, about 12 g. a day. This protein was chosen because it is known to have the highest biological value, is generally well accepted by the patients, and may be employed to make several dishes. The essential aminoacids, which were used in the early period of this study, were later abandoned for practical reasons.

Over 100 patients with chronic renal failure and azotemia have been treated with this diet during the past 20 months, but many of them did not have uraemic symptoms and some others were dialyzed - these cases were not included in the present report. We are concerned here with 34 chronic renal patients with uraemic symptoms, who were treated with the conservative

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regime alone, that is, with the diet described. These patients had a mean urea clearance of 4.20 ml./min., a mean plasma creatinine concentration of 8.25 mg.%, and a mean plasma urea concentration of 204 mg.%. 

RESULTS

A fall in the plasma urea concentration was observed in all the patients, on commencement of the basal protein-deficient diet (Figure 2). In those who had severe anorexia this fall was less steep than in those who were able to take large amounts of calories from the start – consequently different periods of time were needed to bring the plasma urea to its lowest value. This lowest level was higher in the patients with more severe impairment of renal function, and the normal levels of plasma urea were reached only when the urea clearance was higher that 3.0 ml./min. (Figure 3).

The minimal level of plasma urea was recognized by the fact that no further decrease was obtained however long the basal protein-deficient diet was continued, and, at this point, the egg proteins were given. This supplementary nitrogen did not cause a significant increase in the plasma urea, even several months after the patients were discharged, provided that renal function remained constant (Figure 3).

The behaviour of the nitrogen balance during the dietetic treatment, explains the changes in the plasma urea concentration.

When the basal protein-deficient diet was followed, the nitrogen balance was negative, but, when the egg proteins were added, it reached equilibrium or became slightly positive. During the basal protein-deficient diet, the estimated urea production decreased and reached a minimal level, the mean value of which was 3.15 g./day, and if the renal function remained constant, a proportional decrease in the plasma urea concentration was, obviously, obtained. When the egg proteins were added, no significant increase in the estimated daily urea production occurred (Figure 4) and, consequently, no significant changes in the blood urea concentration were observed, provided renal function did not change significantly.

Plasma creatinine concentrations did not change during the diet, except in patients whose renal function changed. Even under these circumstances, therefore, a change in plasma creatinine indicates a change in renal function. Plasma urate concentrations decreased and plasma bicarbonate concentrations increased significantly. Plasma proteins and the electrophoretic pattern, as well as the liver function tests, showed no significant abnormalities during the whole period of treatment.

All the treated patients were anaemic when admitted, and many received transfusions of packed red cells. Lately, if the renal function remained constant or improved, the red cell count also remained constant or improved, but, when renal function deteriorated further, a progressive anaemia occurred and packed red cell transfusions were required again.

High blood pressure was a problem in most of the patients and almost all required hypotensive drugs. The arterial pressure was often reduced after a period of an almost sodium-free diet, but, at the same time, a decrease in the renal function occurred and sodium was therefore, given again. Once more the arterial pressure increased, despite the hypotensive drugs and despite the fact that the sodium balance was in equilibrium.
Many patients had no significant changes in renal function during dietary treatment, as can be established on the basis of the urine output, urea clearance and plasma creatinine concentration (Figure 5). One patient showed a significant increase and 8 a decrease. There was no evidence that the protein-deficient diet itself, caused impairment in the renal function, unless sodium depletion was produced.

If we divide the patients into three groups, according to the residual renal function, it appears that the patients with a urea clearance higher than 3 ml./min. and a plasma creatinine concentration lower than 10 mg.%, could be maintained symptom-free with only 3 exceptions. Patients of this group gained weight and were completely rehabilitated as long as renal function remained constant. We have 5 patients in fairly good condition, for 12 months or more from the beginning of treatment. Of the 3 exceptions one had silicosis, one a chronic empyema, and the third a severe mitral stenosis.

In the patients with a urea clearance between 1.5 and 3.0 ml./min. and a plasma creatinine concentration between 10 and 20 mg.%, a symptom free state was obtained, only for short periods of time, in some patients. Finally, when impairment of renal function was more severe, the dietetic treatment was not sufficient to prevent the uraemic syndrome.

Causes of death in 12 patients who died during treatment were as follow: 5 patients died from cardiac failure and malignant hypertension, 4 died from associated diseases, and 3 died in uraemia caused by a progressive deterioration in renal function.

CONCLUSIONS

The conclusions of our experience may be summarized in a few words: chronic uraemic patients without complications, may be maintained in a symptom-free state if their urea clearance is higher than 3.0 ml./min., corresponding to a plasma creatinine concentration lower than 10 mg.%.

When complications are present, results are worse, because the production of the protein catabolites can not be reduced as usual.

When renal function is more severely impaired (urea clearances < 3 ml./min.) the results are progressively poorer, until a limit is reached (urea clearance about 1.5 ml./min.) below which it is not possible to prevent the uraemic syndrome with conservative treatment alone.
Figure 1. The ranges of the protein content per 1,000 calories of natural and manufactured foods. Among natural foods only some fruits have a very low protein content but also their caloric content is very low and it is practically impossible to give with them a high caloric diet.

Figure 2. The behaviour of the plasma urea concentration in patients on the low protein diet. The plasma urea decreased to a minimal level during the basal protein-deficient diet and patients were discharged. An increase in the plasma urea level was observed only in the patients whose renal function decreased.
Figure 3. Relation between the urea clearance and the plasma urea concentrations before, and after the dietetic treatment was followed. Plasma urea levels shown are the lowest ones obtained.

Figure 4. The lowest levels of the estimated urea production during the basal protein-deficient diet and when the egg proteins were given for 30 days.

Figure 5. The behaviour of the renal function as indicated by the plasma creatinine concentration, during the low protein diet.