Nutritional Aspects of Acute Glomerulonephritis

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ADDIS[1] has stated that there is "complete anarchy" in the modern teaching of the role of diet in the treatment of glomerulonephritis. Rudebeck[2] has also emphasized the contradictory and diverse opinions which have been expressed regarding appropriate therapy of this disease. Many authors[3-10] today may recommend a dietary regimen differing little from that outlined 40 years ago.[11] Thus, both contradiction and lack of change have resulted from an inadequate experimental foundation for the clinical management of acute glomerulonephritis. A theoretical basis for treatment has been proposed by Addis,[1] who has reported extensive supporting experimental observations. Fahr and Smadel[12] have studied the effect of the amount of dietary protein on the course of experimental glomerulonephritis. There have been a few attempts[13-16] to evaluate the importance of dietary protein in the treatment of nephritis by controlled studies in humans. Other opinions on optimal treatment have been based only on theoretical considerations or uncontrolled observations of patients with the disease.[16]

PATHOGENESIS AND PROGNOSIS

Acute hemorrhagic glomerulonephritis is generally considered to result from an antigen-antibody reaction precipitated by infection with the beta-hemolytic streptococcus,[4] of which Type 12 has been particularly implicated.[17] The acute disease involves both kidneys diffusely with apparently complete recovery resulting in most cases.[4] Indeed, healing is reported[18-20] to occur in 95 per cent or more of children who recover from the acute state of the disease. In adults, however, chronic nephritis seems to result more frequently, with only from 60 per cent[18,21] to 80 per cent[2] recovery reported. Death occurs in the acute phase in 2 to 5 per cent of the cases.[1,21] Convalescence in some patients may be extremely prolonged. Addis[1] has stated that, even if the urinary sediment remains abnormal for two years or more after the attack, complete recovery may still occur.

GENERAL TREATMENT

There is little disagreement on the nondietary aspects of treatment. If there is still evidence of streptococcal infection of the pharynx, middle ear, skin, or elsewhere, appropriate antibiotics should be prescribed.[3,5] It has also been suggested[8] that even where there is no residual evidence of infection, penicillin therapy is indicated. The importance of bed rest until hematuria has subsided and the sedimentation rate has become normal is generally accepted.[3] Heart failure may be treated with digitalis and sodium restriction,[10] and hypertensive encephalopathy with parenteral magnesium sulfate.[16] It has also been shown that during the early phases of glomerulonephritis, renal blood flow may be improved by the use of this agent.[23] There is little evidence of benefit from nitrogen mustard or corticotropin (ACTH) in acute glomerulonephritis.

DIETARY MANAGEMENT

Concern with diet has keynoted most discussions of the treatment of this disease.[3] Implicit in diet therapy has been the aim to minimize the requirements for excretory function by the kidney.[1,3] Early diets consisting only of large quantities of milk were recom-

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mended at a time when the azotemia of acute nephritis was considered to be the result of renal tubular obstruction by casts and debris. This regimen, however, usually failed to increase the urine volume and often led to increased edema. It has also been criticized as providing excessive amounts of protein.[3] At the other extreme is the regimen recommended by Volhard,[24] who advocated almost complete prohibition of food or liquid for the first few days of the disease. Diets rich in carbohydrate and fat, but poor in protein, salt, and water were also among the early diets recommended.[3] More recently "the importance of a qualitatively and quantitatively adequate diet especially in protracted cases" has been emphasized.[2]

Renal Work

Reasoning by analogy with the principles of the treatment of other tissue injury, Addis[1] has re-emphasized the importance of rest for the kidney injured by glomerulonephritis. He reasoned that the important work of the kidney is the resorption of water from the tubule against the resisting force of the increasing osmotic pressure exerted by the contents of the tubular lumen. The higher the degree of concentration of any single urine constituent during the process of urine formation, the more effectively does it increase the osmotic pressure of the tubular lumen contents. Since urea is concentrated over 60 times during the conversion of the plasma ultrafiltrate to urine, and since the daily amounts excreted are large, Addis[1] was able to calculate that over three-fourths of the theoretical osmotic work performed by the kidney was related to the excretion of urea.* Since urea excretion increases with increased protein intake, he suggested that the work of the kidney could be directly related to the amount of protein ingested.

Leiter[27] has advanced an additional theoretical basis for the restriction of dietary protein, namely the effect on antibody production. When the protein content of the diet is quantitatively or qualitatively deficient, antibody production is impaired.[28] He has suggested, accordingly, that a possible virtue of protein restriction in acute glomerulonephritis may be a decrease in the production of the antibodies considered responsible in the pathogenesis of the disease. There are no clinical data to support this possibility, but relevant experimental observations have been reported by More and Waugh.[29] These workers found that "mild starvation" seemed to protect against the development of experimental glomerulonephritis. The applicability of this concept to human glomerulonephritis, once developed, remains to be established.

Addis[2] has supported his contention by a series of experiments showing that the size of the rat kidney increases as the protein intake is increased. Studies by him as well as by Camara, Reimer, and Newburgh[25] have shown that the osmotic work of the kidney in humans with normal or diseased kidneys also increases with increase in the protein content of the diet. Addis,[1] furthermore, showed that animals with 75 per cent of their renal tissue removed had a progressive decrease in urine urea and an increase in blood urea with increasing protein in the diet. These studies corroborate the effect of dietary protein on renal osmotic work, but they do not prove that the completeness of recovery from nephritis is enhanced by protein restriction during the acute phase, or that chronic nephritis is more likely to develop in patients taking a normal or high protein diet. More closely related to the problem is the work of Fahr and Smadel.[12] These investigators found that rats with Masugi nephritis, considered by some to be an analogue of human glomerulonephritis, improved or recovered when maintained on a low protein diet. Those fed a high protein diet, however, worsened and died. Similarly, Addis[1] showed that the survival rate of rats with three-quarters of their kidney tissue removed increased progressively with decrease in dietary protein. McCann[30] has objected, however, to the applicability of the data obtained from nutritional studies in

* Addis[1] and Camara, Reimer, and Newburgh[25] used the following formula of Von Rohrer[26] or a modification of it. Work = NRT (2.3 log. U/B − (U − B/U) in which N = Mols of excreted substance; R = the gas content; T = absolute body temperature; U = concentration of the substance in the urine, and B = concentration of the substance in the plasma.

experimental glomerulonephritis to the treatment of humans with nephritis.

Clinical Studies

Indeed, Schwenson,[13] in a study of a small group of patients, with "unsatisfactory"[16] controls, reported earlier recovery in patients receiving a high protein diet than in those whose dietary protein was restricted. Naeraa[14] and Mortensen[15] were unable to demonstrate any clinical advantage in patients receiving a low protein diet. Illingsworth, Philpott, and Rendle-Short[16] in a controlled study could demonstrate no significant differences in the speed of recovery between a group of children receiving a diet low in protein (0.25 g per lb) and a control group partaking of liberal amounts of protein (1.23 g per lb). The marked difference between the prognosis of acute nephritis in adults and children,[18] however, makes the application of the results of this study difficult to apply to adults. Addis[1] has stated, too, that his "clinical experience of many years" has "seemed to confirm" the theory of the importance of protein restriction.

Despite these controversial data on the validity of restriction of protein in the treatment of acute nephritis, there are important areas of agreement in the regimens suggested by Addis,[1] Fishberg,[3] Earle,[4] Pratt,[5] Merrill,[6] Lindberg,[7] and Schreiner.[8] These workers recommend marked protein restriction at the onset of the disease. Others[2,9,10] emphasize the importance of protein restriction only when there is azotemia, and state that in the milder episodes of acute nephritis such restriction is not necessary. The amount of protein recommended by Addis[1] for the acute phase of the disease is 0.2 g per kilogram body weight.

Diet in Convalescent Phase

The rate of increase of dietary protein during convalescence has depended on several criteria. Derow[9] has indicated that "a more liberal diet" may be instituted after edema, oliguria, and hypertension have subsided. Fishberg[3] has stated that "after a few days" more protein may be allowed, while Addis[1] has emphasized the importance of the urinary sediment in indicating sufficient improvement to allow an increase in the protein intake. A significant decrease in the rate of epithelial cell excretion has been interpreted[1] as sufficient evidence of improvement to allow successive but small increases in the amount of protein up to 0.5 g per kilogram of body weight for the adult and 0.75 g per kilogram for the child. In the regimen of Addis[1] larger amounts are not given at any time until complete healing has apparently occurred. When in subsiding nephritis or thereafter, there is marked proteinuria, with or without the fully-developed nephrotic syndrome, he has recommended that the protein ration shown above be supplemented by an amount equal to the daily urinary loss of protein. It is with this prolonged protein restriction that most workers do not agree. Fishberg,[3] Derow,[9] Rudebeck,[2] and others[4,5] have recommended that there be no limitations of dietary protein beyond the acute phase of the disease. Indeed, a high protein diet has been recommended for patients with marked proteinuria since the pioneer observations on the nephrotic syndrome by Epstein.[31] But further discussion of the treatment of this stage of glomerulonephritis is not within the scope of this communication.

It has recently been emphasized that restriction of dietary protein must be accompanied by an adequate calorie intake.[32] Kolff,[33] Borst,[32] and others[1] have shown that fasting is as deleterious in uremia as is protein feeding, since endogenous protein catabolism releases urea and potassium. These workers have utilized the protein-sparing effect of a diet high in carbohydrates and fat in the management of acute renal failure. This rationale also seems to apply to the treatment of acute glomerulonephritis.

There is general agreement that the intake of sodium chloride should be restricted when there is edema and hypertension.[1-11] Earle[4] has stated that dietary salt should be low even in the mildly ill patient. This restriction may be removed when the patient has returned to clinical normality.

It has been emphasized[4] also that the fluid intake should be sharply limited to no more than 700 ml daily in the oliguric or anuric patient. This approach may need modification

in the presence of vomiting and dehydration.

CONCLUSIONS

Restriction of dietary protein during the azotemic, oliguric phase of acute glomerulonephritis is generally accepted. It is difficult to establish clinically the validity of limitation of protein restriction in the absence of uremia or during convalescence. Nevertheless, the author believes that the protein intake recommended for the mildly ill or convalescent patient should follow the regimen of Addis, since the theoretical basis for such dietary restriction seems reasonable, and is supported by the animal studies. There is no evidence of an adverse effect of this regimen and the amounts of protein allowed are sufficient to maintain nitrogen balance. Restriction of sodium chloride should be practiced at least during the edematous hypertensive phase of the disease and perhaps beyond.

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