USE OF RENAL BIOPSY TO PREDICT THE CLINICAL RESULT OF HEMODIALYSIS IN CHRONIC RENAL DISEASE

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IN spite of the growing use of hemodialysis and the increasing appreciation of the value of the renal biopsy, we have been unable to find reported series that correlate the two procedures. It has been noted in general, however, that the "worse the glomerulus, the worse the prognosis".[1] When patients in chronic renal failure did not respond to the best medical management we were able to give them, they were considered to be candidates for dialysis. Therefore, we have been able to observe the course of many patients with chronic uremia who received treatment with the artificial kidney. Renal biopsy studies were done in some of those patients and the results are discussed in this report.

Materials and Methods

Seventeen patients who had chronic renal failure for more than one month, and who each required at least one hemodialysis, each had a diagnostic needle biopsy of the kidney soon after initial admission to the hospital.† Their ages ranged from 14 to 64 years, with an average of 41 years. Each dialysis was performed with a twin-coil disposable artificial kidney.[2]

Each renal biopsy specimen was analyzed according to its individual components. The histopathologic changes of the glomeruli were graded from 0 to 3+ as observed with light microscopy: 0, essentially normal glomeruli; 1+, damage involving at least one of the glomeruli (cellular proliferation, capsular adhesions, or thickening of the basement membrane); 2+, destructive changes involving from one-third to two-thirds of the glomeruli; 3+, destruction of the glomerular pattern of more than two-thirds of the glomeruli *(Fig. 1)*. Other histopathologic changes studied included evidence of tubular alterations, variations in the interstitium, and vascular damage.

The histopathologic changes of each renal specimen were correlated with the patient's history, the physical examination (such as the duration of symptoms prior to admission, degree of edema, funduscopic changes, blood pressure); serum albumin content, the initial blood studies, urinalysis, urinary urea and electrolytes, renal size (determined from roentgenograms), daily urinary volumes, and the clinical course while in the hospital.

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†Many of the patients were under the joint care of Dr. David C. Humphrey, the Department of Hypertension and Renal Disease, and Dr. Willem J. Kolff, the Department of Artificial Organs. Most of the renal biopsies were performed by Dr. Eugene F. Poutasse, the Department of Urology.

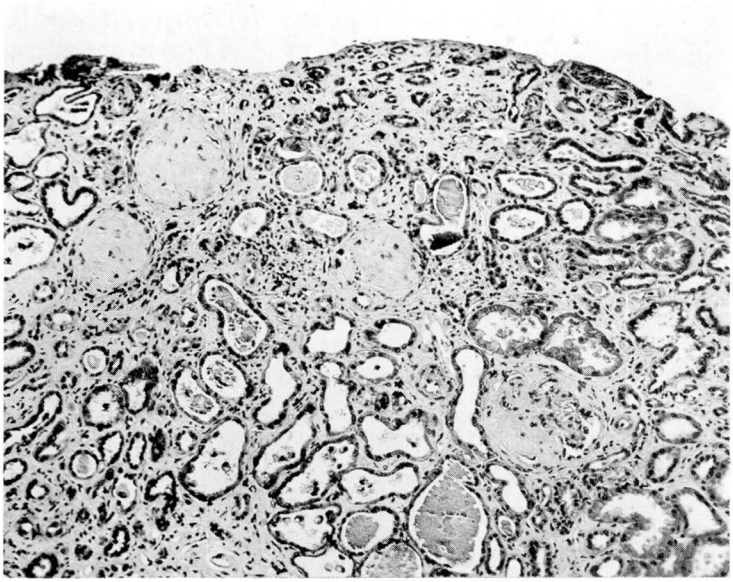

Fig. 1. Photomicrograph of a needle biopsy specimen showing chronic sclerosing and proliferative glomerulonephritis of severe degree, hematoxylin and eosin stain; magnification X 120.

The clinical responses to hemodialysis were graded from 0 to 3+, determined at the time of death, or at time of discharge after the first hospital admission. Death is designated by 0; 1+, uremia that was progressively worse after each dialysis with no hope of arresting the disease; 2+, stability of the uremic state at the time of discharge; 3+, azotemia approaching normal levels. The 2+ and 3+ responses to treatment are considered favorable; the 0 and 1+ responses, unfavorable.

Results and Correlations

The most important and significant correlation is illustrated in *Figure 2*—the severity of the glomerular changes and the therapeutic response in chronic glomerulonephritis. Of the five patients with favorable responses (2+ or 3+) to hemodialysis, only one patient had more than 60 per cent glomerular destruction. On the other hand, of the 11 patients with severe glomerular destruction (3+) only one patient had a favorable response to hemodialysis. There was little correlation between the degree of vascular histopathologic changes and the clinical response to dialysis. The degree of tubular changes, especially atrophy, seemed to parallel the range of glomerular change.

The presence of aggravating or associated illness such as essential hypertension, congestive heart failure, or infection did not affect the final outcome to any noticeable extent. The prognosis was unrelated to the age of the patient. Although the results in patients with fundal hemorrhages, exudates, or papilledema were

less favorable than those in patients free of these conditions, the changes were unrelated to histopathologic changes. Of particular importance is a lack of correlation of renal size, as determined by the roentgen examination, and the prognosis or the response to therapy.

Of the three patients who had stabilized azotemia (2+) at the time of discharge, one died six months and one three months later; however, after dialysis they

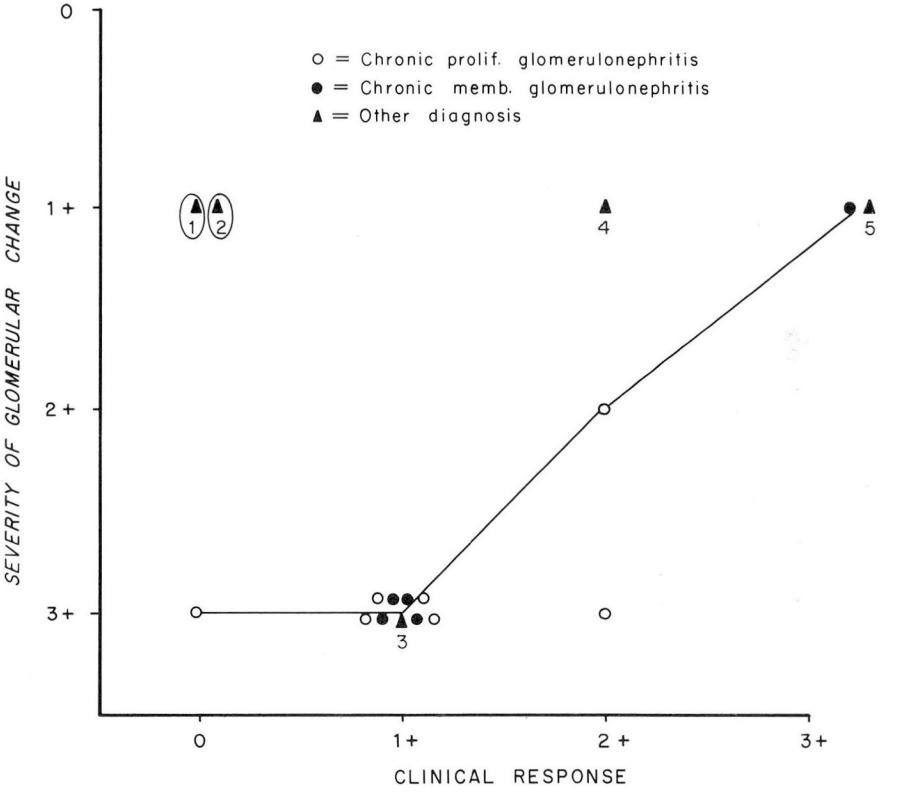

Fig. 2. Graph showing the correlation of the clinical responses of patients treated with the artificial kidney with the extent of glomerular damage as determined by the histopathologic changes in specimens from needle biopsies of the kidneys. For the ordinate, 0 means no pathologic changes and 3+ means more than two thirds of the glomeruli destroyed. For the abscissa, 0 means death of the patient and 3+ means improvement of the patient's condition with loss of azotemia. The triangular markers denote renal disease other than chronic glomerulonephritis. The two encircled markers are excluded from the final evaluation of results, as they are dependent upon factors other than primary renal disease. Patient 1 had primary hyperparathyroidism with nephrocalcinosis and pyelonephritis, and died of a cerebral accident. Patient 2 had severe primary malignant hypertension. Patient 3 had subacute glomerulonephritis with its typically fatal course within a few months. Patient 4 had "pure" chronic pyelonephritis, but only one glomerulus was seen in the biopsy specimen. Patient 5 had membranous glomerulonephritis.

enjoyed life with moderate strength and comfort. The third patient, who is alive seven months later, is becoming cachectic and must undergo repeated hemodialyses.

Discussion

When should the clinician employ the artificial kidney to treat uremia in chronic renal disease? It is a foregone conclusion that hemodialysis will be of immediate benefit; but the ultimate prognosis or even the response during the immediately postdialytic hospital course has not been predictable. Death is usually the final outcome as measured in months after diagnosis, but we believe that the survival interval often may be lengthened and that the patient may be offered a more comfortable existence by using dialysis rather than conservative treatment alone.

Our results suggest that the renal biopsy study is the best method of selecting those patients who may benefit from hemodialysis. Those with little or no glomerular destruction responded favorably to this vigorous treatment, whereas only 1 of 11 patients with severe glomerular destruction responded favorably for longer than a few days. The urinary output and fundal changes are helpful but not dependable factors in regard to prognosis. The presence or absence of hypertension or the size of the kidneys seems to be of no prognostic help.

The general diagnosis, usually best established by renal biopsy, also may be of importance in predicting the prognosis. Most of the 17 patients in our series were diagnosed as having some form of glomerular disease. It seems that patients with polycystic disease or chronic pyelonephritis with no overwhelming glomerular destruction have a more protracted course of renal failure and are more likely to be benefited by dialysis,[3-5] even in the end stage of the disease, than are patients having primary glomerular disease.

There is a need for much additional study to correlate the course of chronic renal disease with the histopathologic evidence from renal biopsy specimens. According to our analysis, renal biopsy seems to be of definite value to the clinician in selecting patients who might benefit for more than a few days after treatment with the artificial kidney. However, in the near future, improvements in the artificial kidney may overcome its limitations of today. Since it has been possible to maintain patients without excretory function for 74 days,[6] and more than 80 days,[7] and for five months,[8] dialysis is limited only by practical impediments and not by theoretic principles.

Summary

Seventeen patients with severe chronic renal disease required treatment with the disposable artificial kidneys. Their clinical responses during the first hospital admission were correlated with the histopathologic evidence in renal biopsy specimens and with the important clinical and laboratory studies. The extent of glomerular destruction seems to be the best means of predicting the response to treatment with the artificial kidney. The need for more extensive studies is stressed.

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