peritoneal dialysis (CAPD) affords the advantages of freedom from a machine, ability to be performed at home, rapid training, minimal cardiovascular stress, and avoidance of heparin [35]. Some enthusiasts believe CAPD to be “a first choice treatment” for diabetic patients with ESRD [36]. Consistent with the author’s view, however, is the report of Rubin and colleagues [37]. They found that in a largely black diabetic population, only 34% of patients continued CAPD after 2 years, and at 3 years, only 18% remained on CAPD.

In fairness, comparisons of either mortality or comorbidity in patients receiving hemodialysis versus peritoneal dialysis suffer from the limitations of starting with unequal cohorts reflecting selection bias. Data subsets from the United States Renal Data System (USRDS) report for 1997 [1] show that in diabetic patients, all cohorts have a higher risk of death with CAPD than with hemodialysis. Furthermore, patients receiving peritoneal dialysis in the United States have a 14% greater risk of hospitalization than do patients undergoing hemodialysis [38]. Benefits of peritoneal dialysis, including freedom from a machine and electrical outlets and ease of travel, stand against the disadvantages of unremitting attention to fluid exchange, constant risk of peritonitis, and disappearing exchange surface.

There are no absolute criteria for abandoning conservative management in favor of initiating maintenance hemodialysis or peritoneal dialysis. As a generalization, diabetic individuals with progressive renal disease decompensate with uremic symptoms earlier than nondiabetic individuals. A decision to start dialysis is usually the culmination of unsuccessful efforts to regain compensation after episodic dyspnea due to volume overload or nausea and a reversed sleep pattern characteristic of renal failure. Sometimes, both physician and patient appreciate that lassitude and decreasing activity in a catabolic patient signal the need to begin dialysis.

**FIGURE 1-47**
Uremia therapy, conservative management. Although enthusiastically favored in Canada and Mexico, in the United States peritoneal dialysis sustains the life of only about 12% of diabetic patients with end-stage renal disease (ESRD) [1]. Continuous ambulatory

**FIGURE 1-48**
Treatment for end-stage renal disease (ESRD). Ideally, treatment for ESRD should be selected without stress or urgency on the basis of prior thought and planning. Discussions with representatives of patient self-help groups, such as the American Association of Kidney Patients, and institutional transplant coordinators aid in communicating the information required by patients to enable them to select from available options for uremia therapy.

**FIGURE 1-49**
Management with dialysis. As tabulated in the 1997 report of the United States Renal Data System [1], diabetic patients with end-stage renal disease (ESRD) are less likely than nondiabetic patients with ESRD to receive a kidney transplant and are most often managed with maintenance hemodialysis (center hemo). A greater proportion of diabetic patients with ESRD are managed with continuous ambulatory peritoneal dialysis (CAPD) or machine-based continuous cyclic peritoneal dialysis (CCPD) than are nondiabetic patients with ESRD.
Survival rates of diabetics and nondiabetics. As tabulated in the 1997 report of the United States Renal Data System [1], there are sharp differences in survival between diabetic and nondiabetic patients with end-stage renal disease (ESRD) as well as between treatment by dialysis versus kidney transplantation. The highest death rate is suffered by diabetic dialysis patients (combined peritoneal dialysis and hemodialysis), while the best survival is experienced by nondiabetic renal transplant recipients. Selection bias in choosing more fit ESRD patients for kidney transplantation while leaving a residual pool of sicker patients for dialysis accounts for some of the difference in mortality. Other variables, especially extrarenal comorbidity, are probably more important in defining the less favorable course in diabetes.

Survival rates of diabetic ESRD patients. After a decade of treatment, the remarkable superiority of renal transplantation over dialysis (combined peritoneal dialysis and hemodialysis, lower curve) is starkly evident in these survival curves drawn from the 1997 report of the United States Renal Data System [1]. Fewer than 1 in 20 diabetic patients with end-stage renal disease (ESRD) treated with any form of dialysis will live a decade. In contrast, kidney transplantation from a living donor (upper curve) or a cadaver donor (middle curve) permits substantive cohorts to survive.

Comorbidity in ESRD. Death of diabetic patients with end-stage renal disease (ESRD) relates to comorbidity, as shown in this table abstracted from the 1997 report of the United States Renal Data System (USRDS) [1]. Representative subsets of patients with ESRD with and without diabetes treated by peritoneal dialysis, hemodialysis, or renal transplantation are shown. Note that for each comorbid cause of death, rates are higher in patients receiving peritoneal dialysis than in those receiving hemodialysis and are lowest in renal transplant recipients. For undetermined reasons, deaths due to cancer are less frequent in diabetic than in nondiabetic patients with ESRD. CVA—cerebrovascular accident; Diab—diabetes; K+—potassium; MI—myocardial infarction.
1.18 Systemic Diseases and the Kidney

**COMPLICATIONS IN PATIENTS RECEIVING HEMODIALYSIS**
- Inadequate vascular access
- "Steal," thrombosis/infection
- Interdialytic hypotension
- Progressive eye disease
- Progressive vascular disease
- Minimal rehabilitation

**COMPLICATIONS IN PATIENTS RECEIVING PERITONEAL DIALYSIS**
- Peritonitis
- "Tunnel" infection
- Abdominal/back pain
- Retinopathy
- Progressive vascular disease
- Minimal rehabilitation

**COMPLICATIONS IN PATIENTS UNDERGOING KIDNEY TRANSPLANTATION**
- Infections: bacterial (AFB), fungal viral (CMV); genitourinary, lung, skin, wound
- Cancer: skin, lymphoma, solid organ
- Drug induced: gout, cataracts
- Allograft rejection: acute/chronic
- Recurrent diabetic nephropathy
- Progressive eye, vascular disease

**FIGURE 1-53** Competitions prevalent in diabetic hemodialysis patients.

**FIGURE 1-54** Competitions prevalent in diabetic peritoneal dialysis patients.

**FIGURE 1-55** Frequent complications reported in diabetic kidney transplant recipients. AFB—acid fast bacteria; CMV—cytomegalovirus.

**OPTIONS IN DIABETES WITH ESRD**

<table>
<thead>
<tr>
<th></th>
<th>CAPD/CCPD</th>
<th>Hemodialysis</th>
<th>Transplantation</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-year survival</td>
<td>75%</td>
<td>75%</td>
<td>&gt;90%</td>
</tr>
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<td>Survival &gt;10 y</td>
<td>&lt;5%</td>
<td>&lt;5%</td>
<td>&gt;25%</td>
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<tr>
<td>Diabetic complications</td>
<td>Progress</td>
<td>Progress</td>
<td>Slow progression</td>
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<tr>
<td>Rehabilitation</td>
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<td>Poor</td>
<td>Fair to excellent</td>
</tr>
<tr>
<td>Patient acceptance</td>
<td>Fair</td>
<td>Fair</td>
<td>Good to excellent</td>
</tr>
</tbody>
</table>

**FIGURE 1-56**
Options in diabetes with ESRD. Comparing outcomes of various options for uremia therapy in diabetic patients with end-stage renal disease (ESRD) is flawed by the differing criteria for selection for each treatment. Thus, if younger, healthier subjects are offered kidney transplantation, then subsequent relative survival analysis will be adversely affected for the residual pool treated by peritoneal dialysis or hemodialysis. Allowing for this caveat, the table depicts usual outcomes and relative rehabilitation results for continuous ambulatory peritoneal dialysis (CAPD), continuous cyclic peritoneal dialysis (CCPD), hemodialysis, and transplantation.

**FIGURE 1-57**
Karnofsky scores in rehabilitation. Graphic depiction of rehabilitation in diabetic patients with end-stage renal disease (ESRD) as judged by Karnofsky scores. Few diabetic patients receiving hemodialysis or peritoneal dialysis must the strength to resume full-time employment or other gainful activities. Originally devised for use by oncologists, the Karnofsky score is a reproducible, simple means of evaluating chronic illness from any cause. A score below 60 indicates marginal function and failed rehabilitation.